



Usability Briefing for hospital design

Exploring user needs and experiences to improve complex buildings

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This PhD thesis is a contribution to an ongoing debate in Denmark about improving the building design processes of complex buildings, especially in relation to the current hospital developments. It provides knowledge about capturing user needs and defines a process model for usability briefing for hospital architecture from a user perspective.

The thesis is based on comprehensive literature studies, three main case studies at hospitals, numerous expert interviews and workshops. The research results generate a better understanding of how knowledge about user needs, acquired from workshops and evaluations, can be fed into briefing and design processes. This PhD thesis proposes methods for usability briefing as a dynamic and continuous process throughout all the building phases.

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Usability Briefing for hospital design



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PhD thesis
April 2016

DTU Management Engineering
Department of Management Engineering

ANETA FRONCZEK-MUNTER

USABILITY BRIEFING FOR HOSPITAL DESIGN

EXPLORING USER NEEDS AND EXPERIENCES TO
IMPROVE COMPLEX BUILDING

PHD THESIS

April 2016

Centre for Facilities Management – Realdania Research

Department of Management Engineering,

Technical University of Denmark

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Aneta Fronczek-Munter

M.Sc. Arch. Eng.

USABILITY BRIEFING FOR HOSPITAL DESIGN

EXPLORING USER NEEDS AND EXPERIENCES TO IMPROVE COMPLEX BUILDINGS

ENGLISH SUMMARY

This PhD thesis is a contribution to an ongoing debate in Denmark about improving the building design processes of complex buildings, especially in relation to the current hospital developments. It provides knowledge about capturing user needs and defines the process model for usability briefing for hospital architecture from a user perspective. The thesis is based on comprehensive literature studies, three main case studies at hospitals, numerous expert interviews and workshops. The research results generate a better understanding of how knowledge about user needs, acquired from workshops and evaluations, can be fed into briefing and design processes. This PhD thesis proposes methods for usability briefing.

Usability is a concept similar to functionality, but usability depends on: subjective view of users, context, culture, situation and experience. Understanding usability is achieved by involving users. This PhD thesis extends the research in usability of buildings to include all building design phases, therefore not only proposes usability evaluations, but also defines usability briefing. *Briefing*, also called *architectural programming*, is usually understood as one of the first phases of a building project. In practice the process, led by experts, involves the users as data sources, and results in the program of requirements for the building.

This PhD thesis synthesizes the research findings and proposes a Usability Briefing process model, where briefing is a dynamic and continuous process throughout all the building phases: from pre-project, through design and construction phases to handover and in-use. In the proposed Usability Briefing model the activities of briefing and design are not sharply divided, but support each other in frequent interactions. User involvement and evaluations support briefing and design by common learning, participatory data collection and analysis of needs. Therefore, the model combines all interrelated activities and provides a visual overview of them throughout all phases. Additionally, the model includes the focus, users and methods for each phase.

Furthermore, this thesis suggests that the practice could go further with user involvement, compared to the usual *user-centred design*, where users passively reveal their needs and the professionals continue with the design. Instead, this thesis proposes a move towards *user-driven innovation* and Scandinavian *participatory design*, where users are seen as partners and co-creators, and where innovation and design are not done 'for' users, but 'with' or 'by' users. Research results from the presented hospital cases demonstrate that user-driven innovation is possible even in the hierarchic and technically advanced healthcare environment, and that patients and medical staff can have a positive influence on the prospected architectural environment, provided that the user involvement occurs early and is managed properly. Moreover, the model incorporates the evaluation activities

in the process, also at the front-end, where evaluation can give input to briefing and design, and can occur as participatory methods, i.e. simulations. In order to choose an appropriate method, the various methods and tools for evaluating facilities are grouped according to their main focus: technical building performance, function/usability or form/beauty. Furthermore appropriate methods are selected specifically for hospital projects.

The results are published in five scientific articles and are summarised in this PhD thesis. It provides tools that contribute to satisfying the needs of future building users and maximising the usability of complex buildings, such as hospitals. The research results have relevance to researchers, architects, facility managers and client organizations planning new complex facilities, and especially for professionals working with briefing and design of hospitals.

BRUGERVENLIG BYGGEPROGRAMMERING TIL HOSPITALS DESIGN

INDDRAGELSE AF BRUGERBEHOV OG OPLEVELSER TIL FORBEDRING AF KOMPLEKSE BYGNINGER

DANSK RESUME

Denne ph.d. afhandling er et bidrag til den igangværende debat i Danmark om at forbedre designprocessen for komplekse bygninger; især de aktuelle hospitalsbyggerier. Afhandlingen bidrager med ny viden om at indfange brugerbehov og brugeroplevelser, og den definerer en proces for *Brugervenlig Programmering (Usability Briefing)* af hospitalsarkitektur ud fra et brugerperspektiv. Afhandlingen er baseret på omfattende litteraturstudier, tre primære case-studier af hospitaler i Danmark og Norge, samt talrige interviews og workshops med eksperter. Resultaterne af forskningen giver en bedre forståelse af, hvordan viden om brugerbehov, indsamlet ved workshops og evalueringer, kan indgå i programmerings- og designprocesser.

Brugervenlighed (Usability) er et koncept relateret til funktionalitet, men brugervenlighed afhænger af brugernes subjektive opfattelser samt af kontekst, kultur, situation og erfaringer. Forståelsen af brugervenlighed opnås gennem involvering af brugerne. Afhandlingen udvider forskningen i brugervenlighed af bygninger fra udelukkende at fokusere på evaluering af bygninger i brug til at omfatte alle byggeriets faser samt definerer Brugervenlig Programmering. *Programmering (Briefing / Architectural Programming)*, bliver ofte forstået som en aktivitet i en tidlig fase af et byggeprojekt. I praksis bliver processen traditionelt varetaget af eksperter, brugere involveres som datakilder, og processen resulterer i et byggeprogram.

Afhandlingen foretager en syntese af forskningsresultaterne og foreslår en proces model for Brugervenlig Programmering, hvor programmering er en dynamisk og kontinuerlig proces gennem alle byggeriets faser. I den foreslåede model er aktiviteterne for programmering og design eller projektering ikke skarpt adskilte, men understøtter hinanden med hyppige interaktioner. Brugerinvolvering og evalueringer af bygninger understøtter programmering og design gennem fælles læring, partcipatorisk data indsamling og analyse af behov. Modellen kombinerer således alle fire indbyrdes afhængige aktiviteter og giver et visuelt overblik af dem i alle bygningsfaser og angiver tillige fokus, brugere og metoder for hver fase.

Afhandlingen foreslår derudover at praksis kunne gå længere med brugerinvolvering end den normale *Bruger-centrerede design (User-centred design)*, hvor brugere passivt afslører deres behov og de professionelle fortsætter med at designe. I stedet kunne praksis bevæge sig hen imod *Bruger-dreven innovation (User-driven innovation)*, og Skandinavisk *Participatorisk Design (Participatory Design)*, hvor brugerne opfattes som partnere og medskabere (co-creators), og hvor innovation og design ikke foretages 'for' brugerne, men

‘med’ eller ‘af’ brugerne. Forskningsresultaterne fra hospital cases demonstrerer at bruger-dreven innovation er mulig selv i det hierarkiske og teknisk avancerede hospitalsmiljø og patienter og medicinske medarbejdere kan have betydelig positiv indflydelse på de arkitektoniske omgivelser. Det er imidlertid afgørende at brugerinvolvering styres og foregår tidligt i processen. Modellen indeholder endvidere evalueringsaktiviteter, også i starten af processen, hvor evaluering kan give input til programmering og design, og de kan også gennemføres med partcipatoriske metoder, f.eks. simulationer. På denne måde kan det undgås at fejl gentages. For at kunne vælge de rette metoder er de forskellige metoder og værktøjer i afhandlingen grupperet i relation til deres primære fokus: teknisk bygningsperformance, funktion/brugervenlighed og form/æstetik; og der udpeges metoder, som er særligt relevante for hospitalsprojekter.

Resultaterne af ph.d. projektet, der er publiceret i 5 videnskabelige artikler og resumeret i afhandlingen, bidrager med værktøjer og kan medvirke til at tilgodese fremtidige bygningsbrugeres behov samt maksimere brugervenligheden af komplekse bygninger som hospitaler. Forskningsresultaterne er af relevans for forskere, arkitekter samt facilities managers og bygherrer involveret i planlægning af nye, komplekse faciliteter – herunder ikke mindst de professionelle, som arbejder med byggeprogrammering og design af hospitaler.

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1. INTRODUCTION

This PhD thesis is a result of a research study at the Centre for Facilities Management – Realdania Research, at the Technical University of Denmark (DTU) in the period of 1. August 2010 – 31. January 2016.

- The PhD study had three supervisors:
- Per Anker Jensen, Professor at Technical University of Denmark, Department of Management Engineering, director of Centre for Facilities Management – Realdania Research (main supervisor)
- Werner Sperschneider, PhD, former Innovation consultant at the Capital Region of Denmark, director at IDEAbility ApS, a hospital bed manufacturer
- Juriaan van Meel, PhD, Co-founder, Senior consultant and partner at ICOP, Senior researcher at Centre for Facilities Management - Realdania Research, Technical University of Denmark

In this chapter I summarise my motivation for this PhD study and briefly introduce the main research concepts, questions, objectives and planned results. In section 1.4 the EMPIRICAL FIELD OF INVESTIGATION is presented. Section 1.5 presents the STRUCTURE OF THE THESIS.

1.1. MOTIVATION AND BACKGROUND

My vision is to improve the building process, in a way that the resulting architecture can support the needs and activities of its users, enrich and inspire them.

When I was starting the PhD project in 2010, I already had six years of experience as an architect in the building industry in Europe, mostly in Denmark, Germany and Poland. Those experiences undoubtedly influenced the focus and approach of the research presented in this PhD thesis. My motivation was the few surprising factors that I noticed in practice. First, there was little time or interest in evaluating and learning from previous projects, especially if some design solutions seemed not to fit the reality and the needs of the users. Second, there was a total absence of the users in the design and decision making process. We, the architects and developers, were of course thinking of the future users, tenants and visitors, but we never met them and asked what their specific needs were. It was a user-centred design approach, where the designers think about the users, but it is the professionals designing and taking all decisions. Furthermore, there was a vast amount of tacit knowledge from the field and experience, but the learning was not systematized and expertise of the companies seemed random and dependent on specific employees. At the same time the construction industry today is plagued by adverse and antagonistic relationships between participants that could be resolved by effectively structured, trust-based collaboration (The American Institute of Architects (AIA), 2007). There is an additional issue, namely in complex buildings, such as hospitals, with many types of users,

INTRODUCTION

it can be difficult to satisfy the numerous, different and often contradictory requirements of all the users.

In Denmark, some of these issues recently got much attention because there are currently planned and built multiple hospital projects, see Table 6, page 58. The introduction question I am asking in this work is: **what can be done to ensure that the end results of those projects will be hospitals of excellent architecture and usability, supporting the needs of future patients, healthcare professionals and society.**

In 2010 I was participating in a few courses at the Technical University of Denmark, among others one in Facility Management with professor Per Anker Jensen, who was searching for candidates for a PhD study. I grasped the opportunity to develop a proposal for a PhD project with him, combining the issues I found could be improved in existing architectural programming and building practice and I started immediately after the proposal received funding from Centre for Facilities Management- Realdania Research at the Technical University of Denmark. In the PhD project proposal I wrote about the need for an improved process of briefing, combining focus on usability, user involvement and evaluations. Furthermore, as the companies nowadays, I also realised, that when projects are carefully programmed, design can start earlier, proceed more efficiently and suffer less client rejections (Duerk, 1993).

This PhD thesis is the summary of the results of the PhD research project. The PhD study was originally planned for three years, as normal in Denmark, but due to two maternity leaves it lasted five and a half years.

1.2. RESEARCH QUESTIONS AND OBJECTIVES

The following sections present the overview of the research questions and objectives of the PhD study. Further details of the research design are presented in section 2.3.

1.2.1. Research questions

Over time the interest developed into two main research questions in this PhD project:

1. How can usability briefing be conducted and what should the process include?
2. How to capture user needs and experiences at healthcare facilities?

There was a development of the research questions over time in the PhD study. Additionally I have formulated following **sub-questions** :

- A. How can the briefing process be organised in hospital design/complex buildings across the building design phases to help create usable buildings? Which kind of activities should occur in different phases?
- B. What should the process of briefing focus on in different phases?
- C. Which methods can be used for effective user involvement in the different phases of the briefing and design process? Which users to involve and when?

- D. How do you choose appropriate building evaluation method for different phases or focus? What to evaluate, when and why? Ki8kk'
- E. How can the results of usability evaluations be transformed into briefing and design processes?

1.2.2. Research objects

- Research questions helped identifying **the research objects to study**, which are following:
- Different processes of user involvement in hospital projects, studying the set ups, stakeholders and their roles, as well as results.
- Usability Briefing, studying the briefing processes at hospitals with focus on usability of the built environment, making a method or set of tools for usability briefing.
- Exploring the potentials of using usability evaluations, POE and evaluations of architecture.
- Investigation of the existing and potential roles of the architects, users, Facilities Managers and other stakeholders in processes of briefing, design, evaluation and user involvement.

1.2.3. Research objectives

The research objectives stayed the same during the PhD project and are following:

The research project aims at creating a deeper understanding of usability focus in briefing and to develop methods to explore user needs and experiences and transform them so they can feed into design processes of the built environments in such a way that the needs of users are satisfied and the effectiveness and usability of facilities is maximised.

The first important objective is to identify and propose what a usability brief could or should include and how the process of usability briefing could be carried out as part of continuous and inclusive briefing. The aim is to find ways of optimising the briefing and design process for improving existing and creating new buildings. The main focus is on the briefing process and its elements, rather than the resulting briefing document.

The second objective is to obtain theoretical understanding and more knowledge about the advantages of user focus in the building sector and further develop the tools and methods of user involvement for organisations and the society. Five relevant research themes are studied in literature and empirically: Usability, User involvement, Briefing, Evaluations of buildings and Design of hospitals. Combining all five concepts can support the learning and building propositions for optimising the briefing and design process of hospital buildings.

1.3. INTRODUCING MAIN RESEARCH THEMES

The two main research questions and objectives were developed into five research themes/concepts, studied further. The concepts are following:

1. Usability
2. User involvement and innovation
3. Briefing/architectural programming
4. Evaluations of buildings
5. Design of hospitals

1. USABILITY. During the last 10 years there has been a new development of research in usability of buildings and workplaces. The concept of *usability* is defined as: “The extent to which a product can be used by specified users to achieve specified goals with effectiveness, efficiency and satisfaction in a specified context of use” (ISO 9241-11, 1998; ISO 9241-210, 2010). In the field of the built environment the research in usability has produced reports with case studies as well as theoretical and methodological reflections (Alexander, 2005, 2008, 2010; Siri H Blakstad, Hansen, Knudsen, & Alexander, 2008). The researchers have identified additional key concepts to usability: Context, culture, situation and experience, well-being and satisfaction of users (Alexander, 2008; Hansen, Geir K., Haugen, Tore, I., Jensø, Monica, Knudsen, Wibeke and Tennebø, 2005) and contrasted usability and functionality.

2. USER INVOLVEMENT can be understood in different ways. Most widely used term is the *User-centered design*, where users should reveal their needs to researchers and practitioners, and are involved in data gathering, but the professionals continue with the design. The main concepts and methods are *Human factors and ergonomics*, *Usability testing* and *Applied ethnography*. *User driven innovation* is a different concept, introducing a ground-breaking change - now innovation and design is not done ‘with’ nor ‘for’ users, but ‘by’ users (Ehn & Kyng, 1987; von Hippel, 2005) or defined less radically as ‘systematic involvement of users’ (Rosted, 2005; Wise, 2008). The third way of approaching it is a participatory design, where users are seen as partners and co-creators. There is a Scandinavian tradition for user involvement in this way.

3. BRIEFING, also called *architectural programming* is usually understood as one of the first phases of a building project. In practice the process, usually led by experts involves the users as data sources and results in the program of requirements for the building. This understanding is challenged by several researchers that propose that briefing should be *dynamic* (Nutt, 1993; Prins, Koolwijk, Volker, & Wamelink, 2006) and *continuous* (Barrett & Stanley, 1999; Blyth & Worthington, 2001, 2010; P. Jensen, Alexander, & Fronczek-Munter, 2011; P.A. Jensen, 2006; Ryd & Fristedt, 2007; Van der Voordt & van Wegen, 2005).

4. EVALUATIONS OF BUILDINGS. There are various methods and tools for evaluating facilities, some of the most known are: *Post-Occupancy Evaluations (POE)* and *Usability Appraisals* (Siri H Blakstad et al., 2008; B. Bordass & Leaman, 2005a; Wolfgang F. E. Preiser,

1989, 2002; Wolfgang F.E. Preiser, 1995). In section 3.4 I have grouped the different known methods according to main focus and added the generic methods. There are evaluation methods focusing on the following: technical building performance, function/usability or form/beauty.

5. DESIGN OF HOSPITALS. It is a research theme of an empirical context. It was studied to get an overview of a specific field, with same building design phases as other building types, but different political, organisational, technological, functional, historical and practical issues. A few relevant theoretical discussions about the empirical context of hospitals and co-designing with users are included.

1.4. EMPIRICAL FIELD OF INVESTIGATION

The empirical field of investigation in the case studies is hospitals – the processes of planning, briefing, user involvement and design for the new hospital facilities, as well as the existing buildings and evaluations of them. The three main cases are:

Case 1 – Healthcare Innovation Lab, public-private collaboration project of the Capital Region of Copenhagen, Denmark, with participants from Herlev Hospital, Technical University of Denmark and private companies, see section 4.1;

Case 2 – Bispebjerg Hospital, Denmark and the processes of competition briefing and user involvement in the new hospital development, see section 4.2;

Case 3 - St. Olavs Hospital, Trondheim, Norway, the processes of user involvement, design and evaluation in all building phases, see section 4.3.

The PhD project also draws upon knowledge and empirical data from literature, expert interviews, site visits at hospitals in other countries and complex facilities and professional workshops with a number of companies and institutions. In other words, this PhD thesis looks into the practice of architectural and engineering offices as well as building clients, and the new practice in briefing - architectural programming, user involvement and user-driven innovation, evaluations and commissioning, and their role in the processes of planning of healthcare facilities.

The literature review on the subjects relevant to understand the empirical field of design of hospitals is presented in section 3.5.

The contributions of this PhD thesis to research and practice are summarised in chapter 6 DISCUSSION AND CONCLUSION, sections 6.2 and 6.3.

1.5. STRUCTURE OF THE THESIS

The structure of this PhD thesis, both as the contents of chapters and the connections between the appended papers is shortly described in this section.

1.5.1. Explaining chapter contents

There are six main chapters that cover the introduction, research concepts, results from case studies and conclusions. This section describes the structure of the thesis in detail.

Chapter 1 is an introduction to the background for the research and both practical and academic implications, as well as the structure of the thesis described in this section.

Chapter 2 describes the METHODOLOGY of this PhD study. The first sections cover the philosophy of science and the position in theory. Section 2.3 describes the research design, including research questions, hypothesis, triangulation of data and methods. The qualitative research methods of case study, interviews and focus groups, as well as the concluding research design are presented in the following sections.

Chapter 3 LITERATURE STUDY summarises and divides the relevant literature to the five research themes of usability, user involvement, briefing, evaluations and design of hospitals, described in five separate sections. First, usability research is described with both the usability evaluation and introducing the new concept of usability briefing. User involvement section gives an overview of different approaches to user participation, explains the concepts of user driven innovation, lead users and boundary objects. The compatibility of usability and user driven innovation is also verified and the connections between the briefing and user involvement are explored. Furthermore the multiple existing evaluation methods are grouped according to their main focus and the appropriate methods applicable in hospital projects are presented. The design of hospitals, both research and practice is described in the section 3.5. The focus is on the special hospital design issues, for example the specific users, politics, the concept of healing architecture but also building phases and co-creation with users in design is described.

Chapter 4 EMPIRICAL STUDIES consists of sections with results from three case studies: Case 1 – Healthcare Innovation Lab (HIL) in Denmark, Case 2 – Bispebjerg Hospital, Denmark, Case 3 – St. Olavs Hospital, Norway. Each of the case studies is described in general, the data collection is specified, the analysis of main results and reflections are presented and conclusions are summarised. There are two additional sections, section 4.4 presents the cross case analysis and section 4.5 contains additional information about the multiple explorative expert interviews and focus group validation workshop.

Chapter 5 USABILITY BRIEFING PROCESS MODEL summarises all the five research concepts and synthesises into a single process model of usability briefing, as described in Paper 5. There is a general introduction and explanation of details in the model and its accompanying table. Additionally the possible uses of the model are explained and results and feedback from focus group validation workshop are presented.

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Chapter 6 DISCUSSION AND CONCLUSION presents the summary of findings and results. The contributions to research and practice are also presented, as well as agenda for future research.

There are also REFERENCES and an APPENDIX , which contains lists of figures, tables, 140 events as interviews and workshops, as well as typical interview guides and a list of all my scientific and popular publications.

The final part, APPENDED PAPERS contains the full text of five papers.

1.5.2. List of papers and a diagram of connections

The PhD thesis is paper based, which means that the main results are published in the articles and summarised in this thesis. The papers cover the five main themes and research concepts that are combined and synthesised in Paper 5 and in this summary. The list of all the papers is available in Table 1 and the connections between them are illustrated in Figure 1.

The five full papers are available in chapter APPENDED PAPERS. There are also two additional papers A and B, marked with grey colour in Table 1, which are not appended, but most of the information from them is included in this thesis.

Table 1 List of all the papers in this PhD thesis, five appended scientific papers and two additional published papers

Number	Title
Paper 1	Usability and user driven innovation - unity or clash?
Paper 2	Towards an agenda for user oriented research in the built environment
Paper 3	Facilitating user driven innovation – a study of methods and tools at Herlev hospital
Paper 4	Evaluation methods for hospital facilities
Paper 5	Usability Briefing – a conceptual process model based on hospital projects
Paper A	User involvement and briefing for masterplan competition at Bispebjerg Hospital (popular article)
Paper B	Usability Briefing - a process model for healthcare facilities (previous version of Paper 5)

Paper 1 is a conference article with literature review of usability and user driven innovation and relates the two concepts, finding that user driven innovation can be one of the tools to support usability of built environment.

Paper 2 is also theoretical, with literature review of existing user oriented research, the many known and new concepts and agenda for future research.

Paper 3 is describing the process and results of Case study 1 (HIL) , where the concept of boundary objects is studied, with the methods and tools for user driven innovation tested at Herlev hospital.

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Paper 4 presents multiple evaluation methods for buildings and groups them according to main focus, as well as proposes the methods applicable at different building design phases in hospital projects.

Paper 5 is a synthesis of all research concepts and case results and proposes a process model for Usability Briefing.

Paper A is a popular article in a professional magazine FM Update about the Case 2 - Bispebjerg Hospital, written in Danish.

Paper B is a conference article, which is a previous version of Paper 5 with Usability Briefing model.

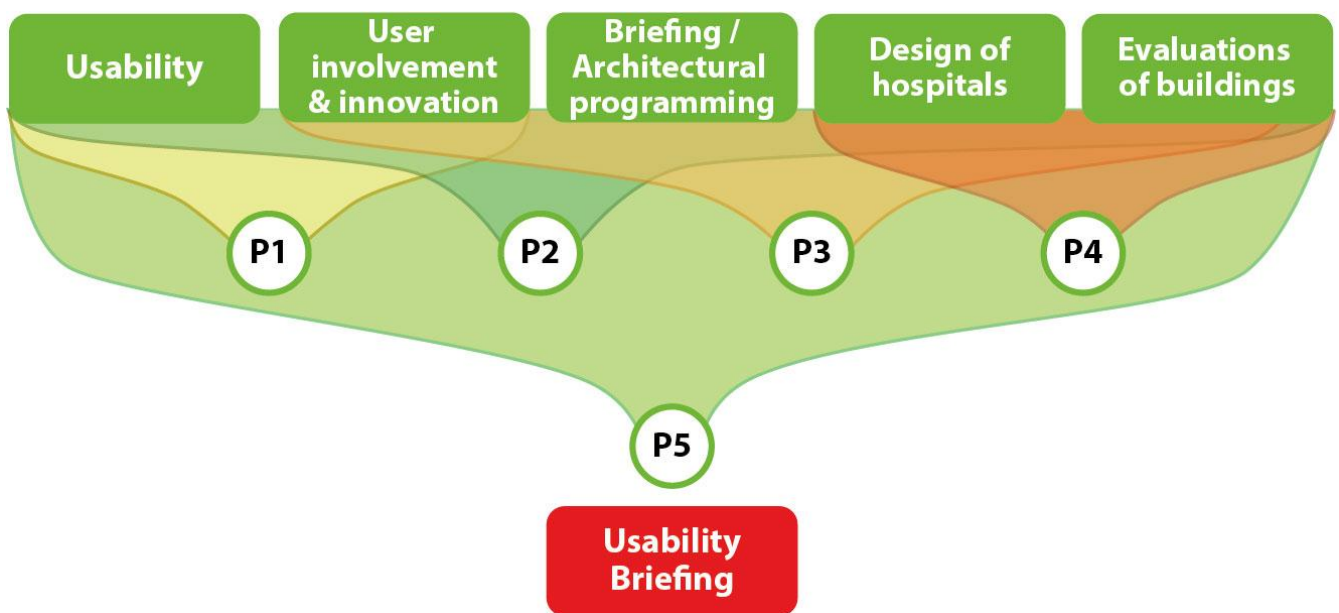


Figure 1 Diagram integrating the research themes and papers covered in this PhD thesis. Paper 5 is a synthesis of all research papers and case results and proposes a process model for Usability Briefing.

2. METHODOLOGY

This chapter presents the methodology of this PhD research. First, the philosophy of science and position in theory are presented. Then, the research design is explained, with the multiple data sources and methods, leading to development of usability briefing model.

2.1 PHILOSOPHY OF SCIENCE

Following the Philosophy of science (Kuhn, 1996) it is investigated what are the assumptions, foundations, methods and implications of science and the specific field.

2.1.1. Ontological assumptions

While trying to understand and answer the Platonic questions, of the type “*is this observation true reality or illusion?*” during my PhD study I position my assumptions, approach, strategies and choices in the *research onion* of Saunders et al., which visually combines the elements of philosophy of science, see Figure 2.

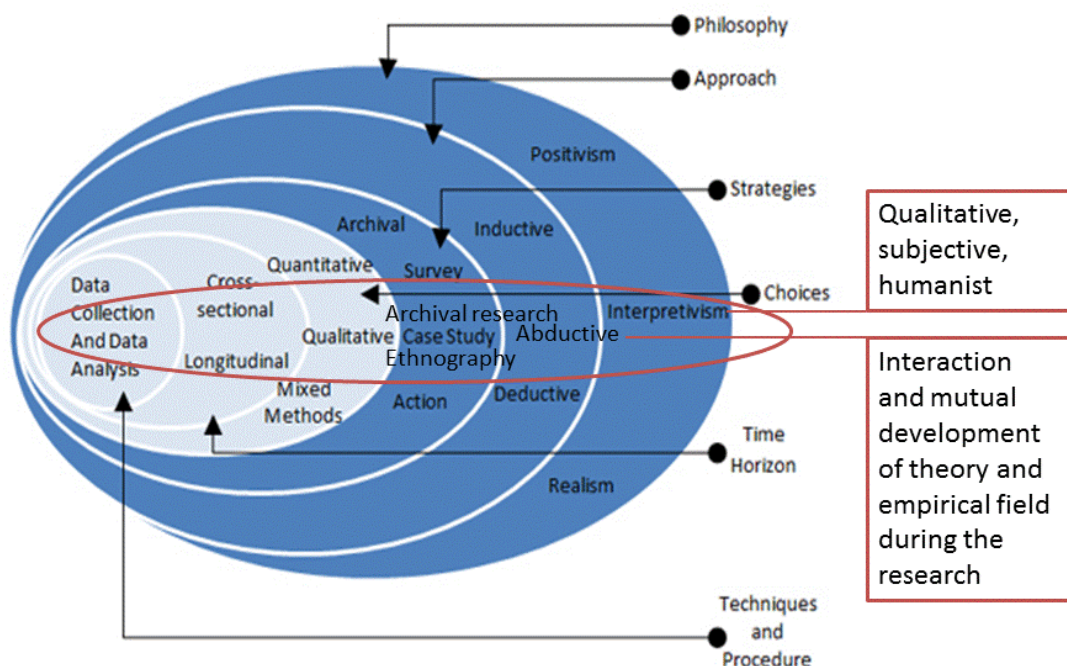


Figure 2 "Research onion" adapted from (Saunders, Lewis, & Thornhill, 2009)

The outer shell covers the philosophical assumption, which in my case is closer to **Interpretivism** (qualitative, subjective, humanist), than to positivism (quantitative, objective, scientific).

2.1.2. Epistemological approach

The next layer in the “Research onion” is Approach which in this study is **abductive**, so that there is interaction and mutual development of theory and empirical field during the research. The study is of mutual simultaneous shaping of factors and the emerging design. Nevertheless, the approach is also **inductive** - as particular examples are used to reach a general conclusion.

The epistemological approach, the nature and grounds of knowledge, is therefore that the researcher interacts with that being researched. This fact might on one hand limit the validity of the study, but on the other hand I argue, that it can simultaneously allow for deeper understanding and positive change in the processes of the studied field.

2.1.3. Methodological strategies, choices and techniques

Understanding that this research is context bound, I chose the methodological strategy of the case study method as the main source of data, with observations and interviews, furthermore supplied by archival research and few ethnographical elements during the case studies. The choice of method is qualitative and to some extent longitudinal, because of long term time horizon, but also to some extent cross sectional, as there are multiple cases in different countries and organisations. Techniques and procedures vary in the case studies and are described in detail in chapter 4 EMPIRICAL STUDIES.

2.2. POSITION IN THEORY – THEORETICAL FRAMEWORK

This section describes the theoretical framework of this thesis.

The scope of this thesis is **Usability Briefing** – the overarching concept, which I have developed on the bases of the different theoretical bases and methods, which were grouped to five main research themes, which were introduced in section 1.3, namely: 1. Usability, 2. User involvement and innovation, 3. Briefing/ architectural programming, 4. Evaluations of buildings and 5. Design of hospitals. Those theoretical concepts and the empirical focus of hospital design are studied in relation to each other in order to develop the concept of Usability Briefing further.

The starting point can be seen in Paper 2, where both well-known and recent theories in user oriented research are summarised. The main concept is Usability, similar to architectural functional quality, an interaction of people and buildings, which is explained in section 3.1. Usability is studied here in the built environment and not as for example man-machine interaction. Usability research is expanded to also include the second main concept – briefing. I develop the comparison of traditional and usability briefing and the Usability Briefing framework or process model step by step, with the theories and empirical data. The five concepts/themes of the study, as shown in Figure 3 are studied and described in chapter 3 LITERATURE STUDY.

I was searching for an overarching theoretical paradigm, a single theory with its specific paradigms behind briefing, user involvement and innovation, behind Evaluation of buildings and design of hospitals. It might be architecture in combination with innovation theories. It might be Design theory with organisational theory or design decision processes. It might also be Facilities Management, Architecture and Healthcare, where Facilities Management is seen as a strategic management discipline, dealing with people, places and processes, Architecture is combining beauty, usability and durability and healthcare or hospital design is an empirical field.

To further narrow the scope of research, I focused on complex buildings, with multiple users, functions and technologies, which would require more efforts to understand the needs and execute the briefing and design processes with usability in mind. Hospitals were chosen as a good example of complex building (see section 3.5.2) with multiple recent major projects as possible case studies. Therefore design of other building types, for example houses or shopping centres are excluded from the study. Criteria for choosing specific hospitals, with different view on users and results are also described in section 3.5.2.

The specific methods, paradigms, values and language differ in the fields of Facilities Management, Architecture, Healthcare/Hospital, Design, Briefing, User involvement, Innovation. On the other hand, they use common theories and I picked the relevant theories and methods that, when combined, supported the development of the overarching concept of Usability Briefing.

2.3. RESEARCH DESIGN

While the research questions were developed, there was also a development of the research design – the way the research was conducted. The overview of the timeline with research steps, the five main concepts and publications is shown in Figure 3. The papers are listed in Table 1 and available in full text in APPENDED PAPERS.

2.3.1. Literature review

Before the empirical data was collected, the international research was investigated. The literature review included following topics: usability, briefing/ architectural programming, user involvement in healthcare projects, design process, needs analysis, building evaluation, user driven innovation, design games, boundary objects, hospital and healthcare planning.

The focus areas were examined in literature and empirical studies and were combined in the new usability briefing model, see Figure 3, top.

2.3.2. Propositions of this research project

The propositions of this PhD project were, unlike hypothesis, that is just tested, built and developed over time, around four parts. First part has been that the combining of existing usability evaluation research with the briefing research might improve the process and results in building sector. Second assumption, developed further was that the usability of buildings can be evaluated with user perspective and can help capturing the future needs of users, including tacit needs. In this way knowledge about user needs and experiences could be extracted by usability evaluations. Moreover, the evaluations could be made not as usually at the end of the building project, but in the preliminary phases, in order to use the knowledge in the briefing for the new building. Third proposition is the active involvement of users in briefing and design processes, which can improve the usability of buildings and user satisfaction. Fourth, that usability briefing should be carried out as part of continuous and inclusive briefing, and might include different activities involving users.

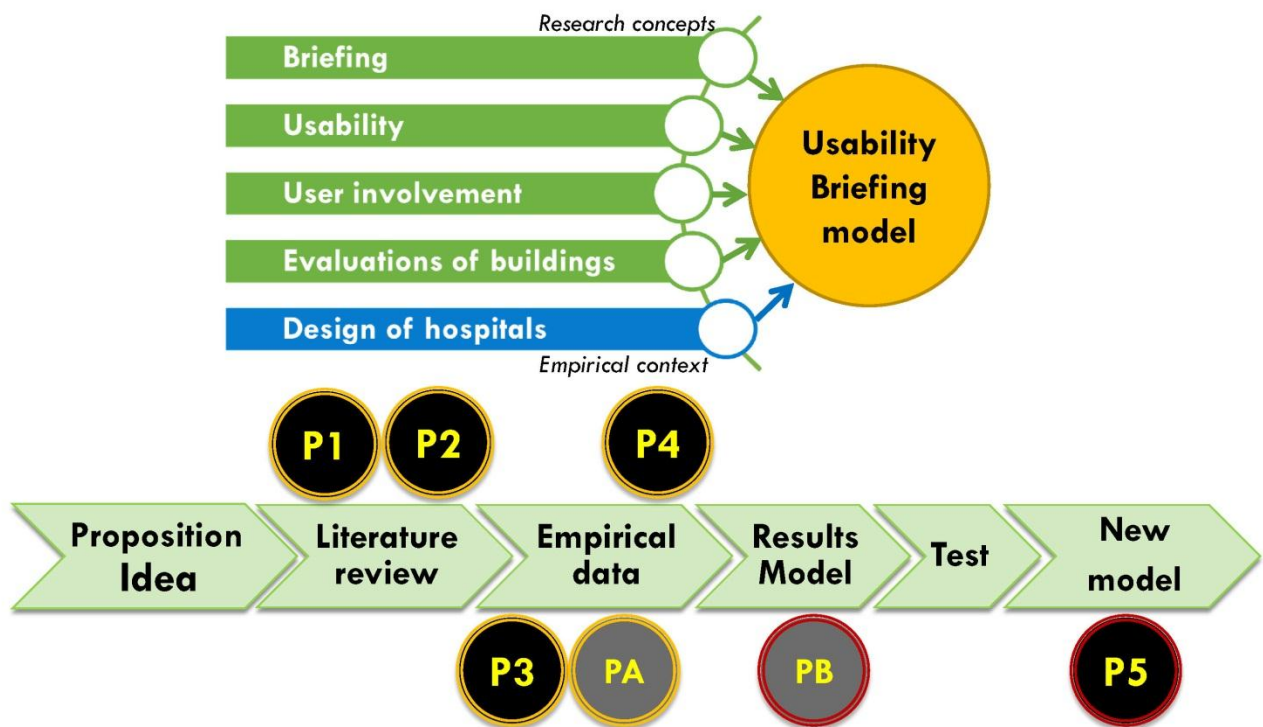


Figure 3 Research design with timeline of the process, five main concepts and papers leading to development of Usability Briefing model, a synthesis of this PhD project, Top: Research concepts and empirical field combined in a usability briefing model, Bottom: timeline and Papers

The proposition developed over time, though there was no aim of verifying it in a positivistic manner, as testing the hypothesis, it was rather a multilinear proposition that was developed and improved over time through the data from the case studies and expert interviews and workshops.

2.3.3. Triangulation of data and methods



I use the triangulation of data and methods as described by (Flick, 2008); Stake, 1995; Bono & McNamara, 2011; Flick, 2008; Jensen, 1991 and Halkier, 2002. In other words, I use multiple data sources and multiple methods to collect data, as described in following sections.

Figure 4 Graph illustrating triangulation of data and methods

2.3.3.1. Triangulation of empirical data

Bono and McNamara (2011) argue, that most single-study designs are flawed in some way, therefore they encourage a strong research design, with conducting a series of studies, multiple studies or samples, each addressing flaws in the other. In this way each study will have its own flaws, but together the studies may allow for stronger inferences and more generalizable results.

I use a triangulation of empirical data; see Figure 5, which builds on data from three main case studies: Case 1 Healthcare Innovation Lab (HIL), Herlev Hospital, Denmark, Case 2 Bispebjerg Hospital (BH), Denmark and Case 3 St. Olavs Hospital, (SOH) Trondheim, Norway. In addition to the case studies, the data is also combined and contrasted with data from additional expert interviews.

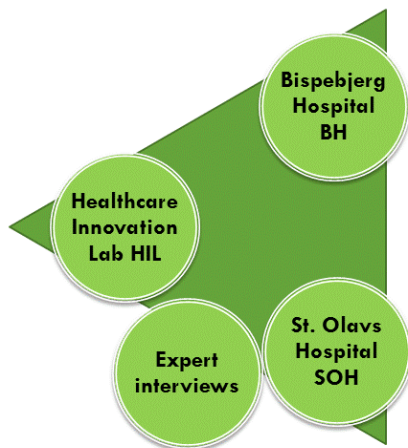


Figure 5 Triangulation of data: three hospital case studies and additional expert interviews

2.3.3.2. Triangulation of methods for collecting data

This PhD thesis has used a triangulation of methods for collecting empirical data, as described by (Flick, 2008; Halkier, 2010; flick).

The research was based on qualitative methods, such as interviews with parties involved in planning and using healthcare environments as well as observations and participation in case studies. The triangulation of methods is shown in Figure 6. The first method, biggest

part at Figure 6, is the case study method (Eisenhardt, 1989; Stake, 1995; Yin, 2003) where empirical data is collected from hospital projects. This method was used in this PhD study in three different ways, which form separate categories of field observation, participatory field observation and reports. The second method is expert interviews, some of the experts were interviewed as participants in the case studies and some were external experts adding more information about the field of hospital design, user involvement, briefing or evaluations, some were additional professional workshops about specific topics and last, there were also study visits and interviews in hospitals and other facilities abroad, as Hospital in Helsinki, Finland. All the interviews were semi-structured. The third method was the focus group interview/workshop (Morgan, 1997) for validation and further improvement of usability briefing model.

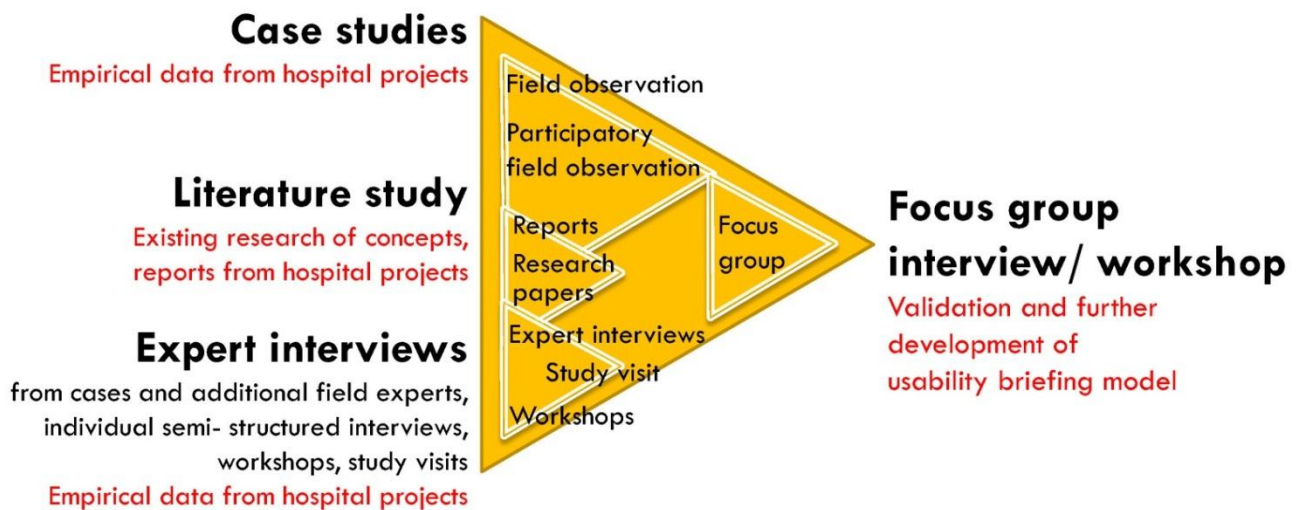


Figure 6 Triangulation of methods

2.3.4. Case study research

As mentioned in section 2.1.2 Epistemological approach, the approach of the study is mostly inductive and particular examples are used to reach a general conclusion. The case study methodology (Yin, 2003)(Stake, 1995) is chosen for the examination of details, for seeking answers to *how* and *why* questions and making broader generalizations and reaching conclusions from existing practices (Yin, 2003). It allows testing speculative ideas and theoretical concepts based on empirical data (Eckstein, 1975; Orum et al., 1991; Ragin and Becker, 1992; Glaser and Strauss, 1967).

There were a number of criteria for choosing those exact case studies. First, I excluded buildings, that are small and the processes of designing them can be simple. Other types of big or complex buildings, i.e. shopping centres or university campuses, were excluded in favour to hospitals, because the hospitals provide biggest variety of users. The specific three cases are quite different in a number of ways. First, I could study different building phases. Additionally, they had a different understanding of users and used different

methods for user involvement. Of course it was also a matter of which cases agreed to contribute to the research study. By choosing the case studies in this way, I tried to maximise what can be learned and interpreted, as suggested by Stake (1995) and not compromise the reality too much (Kulka, 1981). Furthermore, the three case studies were chosen because of novelty and variety of procedures.

In the field observations at the case studies, I make use of own analytic interpretation of the observed events of the user involvement, simulations, innovation, co-creation and evaluations, as suggested in (Halkier, 2010). Some of my case study observations were direct participatory observations and tests of methods as in HIL case with innovation and simulation or SOH case with evaluation methods. Other data comes from expert interviews and literature, in form of historical reports from SOH case to support the information from previous building phases in the same case study.

The specific research methods used in the three case studies are described for each separately in chapter 4 EMPIRICAL STUDIES.

2.3.5. Expert interviews in case studies

The expert interviews, both with participants of the case studies and additional external professionals were executed as semi-structured individual interviews with professionals. “Because the varied professional, educational and personal histories of the sample group precluded the use of a standardized interview schedule; and in order to explore respondents’ opinions, clarify interesting and relevant issues, elicit complete information and explore sensitive topics within each interview, some freedom to probe was essential” (Barriball & While, 1994). Examples of interview guides are included in APPENDIX.

2.3.6. Explorative additional expert interviews, workshops, study tours

Apart of the interviews with professionals involved in the case studies, I also conducted 47 additional explorative expert interviews with architectural, innovation and engineering companies, which are designing hospitals, doing briefing, involving users and/or making evaluations. Furthermore, I also talked with Patient organisation and interviewed medical doctors. In addition to this, I participated in a series of workshops about briefing with the theme “i2p – From Idea to programme”, organised by The Danish Association of Construction Clients (DACC) (Danish: Bygherreforeningen). I also made several short visits to two cooperating Universities and Research Centres abroad: NTNU, Faculty of architecture, in Trondheim, Norway and Aalto University, Built Environment Services Research Group, in Helsinki, Finland. Additionally I made a site visit and interview at Triangle Hospital in Helsinki, Finland. The additional interviews and workshops were explorative in nature and are also described in section 4.5.1. All the 140 expert interviews and workshops are listed in APPENDIX.

2.3.7. Validation of usability briefing concept and model

For validation of the preliminary result in form of usability briefing model and further improvements to it I made expert interviews with two additional architectural firms designing hospitals and involving users, and subsequently I presented the model at a CIB conference. Finally, I organised a focus group interview/workshop (Halkier, 2010; Morgan, 1997) with expert professionals dealing with the topics of hospital planning and briefing, architecture and engineering design, evaluations, user involvement and innovation. The process and participants, as well as the results affecting the new usability briefing model are described in section 5.3. In general the workshop was planned as a further development and fine-tuning the usability briefing model after the discussions with practitioners.

3. LITERATURE STUDY

I made a literature review of the five main theoretical concepts, which were introduced in section 1.3. This chapter describes the concepts thoroughly in following sections: 3.1 USABILITY, 3.2 USER INVOLVEMENT AND USER DRIVEN INNOVATION, 3.3 BRIEFING - ARCHITECTURAL PROGRAMMING, 3.4 EVALUATION METHODS FOR FACILITIES AND THE “FLOWER” MODEL, 3.5 DESIGN OF HOSPITALS.

3.1. USABILITY

The theory is summarized in the following, and the concept of *usability* is described in depth in Paper 1, 2 and 5.

3.1.1. Definition and understanding of usability

The concept of *Usability* is defined by International Organization for Standardization as: “The extent to which a product can be used by specified users to achieve specified goals with effectiveness, efficiency and satisfaction in a specified context of use” (ISO 9241-11, 1998; ISO 9241-210, 2010).

Usability has its roots in evaluations of consumer products and user interfaces of computer software. During the last 10 years there has been a new development of research in usability of buildings and workplaces. Recently researchers have identified additional key concepts to usability: Context, culture, situation and experience. Understanding those might be achieved by involving users.

In Paper 1, usability of the built environment is related to *user driven innovation* - participatory processes in which users are involved in design. The question in this paper is *how* and *to what extent* users can be involved in design processes to create better and *innovative* buildings of *enhanced usability*. The claim is that the two concepts supplement each other and user driven innovation can be used as one of the methods to improve the usability of the built environment. The field of built environment might benefit from a deeper understanding of the concepts and learn from experiences from other fields.

Paper 1 is based on literature reviews of scientific journals and other influential publications on *Usability* and *User driven innovation* within the academic fields of Facilities Management, Architecture and Engineering, Participatory Design and Software design.

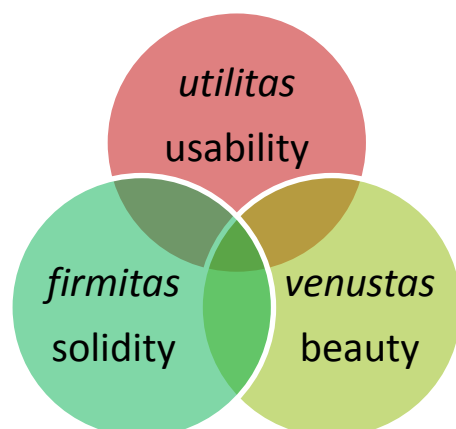
The paper analyses the literature and discusses the different understandings of the concepts *Usability* and *User driven innovation*, depending on the specific field. The analysis is broadening the awareness of possible positive impacts of combining the understandings and experiences with *Usability* and *User driven innovation* from several professional fields. The paper shows the advantages of the *Usability* and *User Driven Innovation* concepts to the field of Built Environment, where they have not been used widely yet. The implications

for practice are therefore mostly gaining deeper understanding of positive values of using the concepts of *Usability* and *User Driven Innovation* by combining existing knowledge from different professional fields in new ways.

Because of the roots of *Usability* in evaluations of consumer products, the concept is most often understood nowadays as *Usability Tests*, which is a method, where the already developed product prototype is being tested in a Usability Lab with a group of potential users to see if it is acceptable and useful for the target group members. That process will often lead to development of additional improvements and making a second prototype. Traditionally the manufacturing companies are themselves developing the prototypes, innovating and making patents in their R&D (Research and Development) departments and only invite the users for the Usability Testing. According to von Hippel it is still the vast majority of manufacturers that think that product and service development are always done by them, and that it is their task to find a need and fill it, rather than finding an innovation that lead users have already developed and commercialise it (von Hippel, 2005). Even though the innovation by manufacturers and usability testing was and still is widespread in many fields, it has been shown that “the traditional pattern of concentrating innovation-support resources on a few individuals is hugely inefficient, because it is hard to determine the right people who might develop a valuable innovation” (von Hippel, 2005)

There has been a shift in the recent years described by von Hippel as “Democratizing innovation”, where more companies turn to *User Innovation*, also called *user centred innovation* or *user driven innovation*, where the users design new products or computer software. The concept of *User driven innovation* is described further in the section 3.2 USER INVOLVEMENT AND USER DRIVEN INNOVATION.

In the field of Architecture the *Usability* concept has in principle been well known for centuries. It was mentioned in writing in Ancient Rome by Vitruvius (80-15 BC), who is famous for asserting in his book *De architectura*, also known as *The Ten Books on Architecture*, that architecture must exhibit the three qualities of *firmitas*, *utilitas* and *venustas* — which means that it must be solid, useful and beautiful (Vitruvius, 1960) Today



most architecture students hear about the three elements in their first architecture history classes. Nevertheless the understanding of the words is not universal, but constantly changing throughout time and place (Paper 1).

Figure 7 Three qualities of architecture, adapted from (Vitruvius, 1960)

According to Hillier et al. (Hillier, Leaman, Stansall, & Bedford, 1976) a building has four main functions: spatial organisation of activities, climate regulation, symbolic function and economic function. The spatial organisation of activities is described as building providing “optimum support for the activities desired by properly arranging the available space” (Van der Voordt & Van Wegen, 2005).

Moreover, *Utility* or *Usability* is often translated to a widely used term in architecture: *Functionality*. Architectural publications describe a *Functional quality* of a building as “its ability to fulfil the functions envisaged for it” (Van der Voordt & van Wegen, 2005). The *functionality* of a building is also described together with four functions listed by Hillier and Leaman, as the extent to which the buildings’ spatial and physical qualities support functions of climate, symbol and economy as well as spatial organisation of activities (Van der Voordt & van Wegen, 2005).

The concept of Architectural quality was described by (van der Voordt and Vrielink, 1987) as an integration of four qualities:

- functional quality
- aesthetic quality
- technical quality
- economic quality

In the field of facility services there has also been made a distinction between *technical quality* and *functional quality*, where the *technical quality*, as the core of the service process is often more important for the clients, but end-users working on premises see *functional quality* as more important (Lehtonen, 2006).

First in the last 10 years there has been a new development of research in *Usability of buildings and workplaces*. The research in usability has been initiated by *CIB W111 Usability of Workplaces* which has produced reports with case studies as well as theoretical and methodological reflections (Alexander, 2005, 2008, 2010). The starting point has been in accordance with ISO 9241-11 to evaluate effectiveness, efficiency and satisfaction of workplaces and the built environment. Blakstad, et al. defines *Usability of buildings* as: “Buildings true purpose is to support and shelter its users, while they are performing their activities and living their lives. (...) Depending how well they support their users’ activities, our physical surroundings contribute to efficiency, effectiveness and satisfaction in the user organisations” (Blakstad, et al. 2010). For more information see Paper 1.

Recently, researchers have identified additional key concepts to usability (Alexander, 2008, 2010): Context, culture, situation and user experience that can strengthen the efforts to understand and improve usability in the built environment (Paper 1).

Alexander distinguishes between *Functionality* and *Usability*. He explains that it is “the use that determines the usability and not the presence of functions. Functions only make certain uses possible” (Alexander 2006, 2008, 2010). Jensen supports the division of *functionality* and *usability*. He describes the traditional strong focus on *functionality* in the

building industry, which is “based on technical rationalism, where the attributes of the products are described in objectively measurable terms” (Jensen 2010). He argues that the introduction of usability concept challenges this approach of technical rationalism by introducing the subjective views of the users (Jensen 2010). The interesting result of this is that usability can be evaluated differently by different groups of users. The example of such differences was found in *Usability* evaluations of Norwegian University College, where students and staff had different perspectives and the results of usability evaluations of the built environment varied considerably (Hansen and Knudsen, 2006, in Jensen, 2010).

Moreover, researchers claim, that evaluating *Functionality* would mean assessing to which degree the building works according to specifications, whereas *Usability* has a broader scope and the focus is on how people utilise the functions to meet their needs, and their experiences from doing so (Blakstad et al, 2010, Paper 1).

Because usability has been researched in a number of studies, with different focus topics a variety of understandings are widespread, see paper 1 and 2. The main direction of usability research has been the development of theory and methods to *capture and evaluate* usability to improve existing facilities and a few focus on *feed forward* to new building projects. As my research is focusing on developing the process of usability briefing for healthcare facilities, I am interested in how to plan the facilities, which are usable for the users. I will therefore in this PhD thesis use the recent understanding of usability, which is summarised in Figure 8.

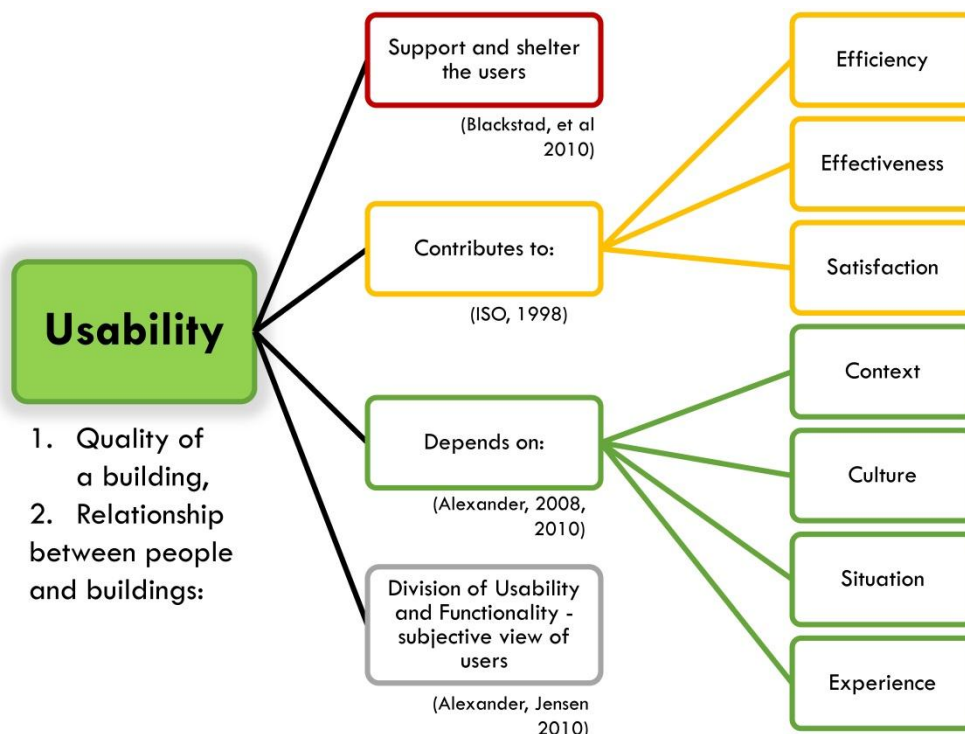


Figure 8 Recent understanding of the concept of Usability and its main ingredients, adapted from Paper 1 (Fronczek-Munter, 2011)

3.1.2. Research focus on usability evaluations

Usability most often refers to evaluating and tests of products. In building industry and research usability most often means usability evaluations/appraisals, which are described in Paper 1, 2, 4 and 5.

The most known usability assessment methodology is *POE – Post Occupancy Evaluation*, described further in section 3.4.2. *Post occupancy* refers to the fact that the building is already taken to use at the point of evaluation. The origins of the method are in the USA and it has been used since the 1960s. According to the definition of Preiser et al. (W F E Preiser, 1989; W. F. E. Preiser, Rabinowitz, & White, 1988; Wolfgang F E Preiser, 1994), POE is "the process of evaluating buildings in a systematic and rigorous manner after they have been built and occupied for some time". The British Council for Offices (British Council for Offices, 2007) suggests two main purposes for a POE: 1) To gain feedback of how successful the workplace is in supporting the occupying organisation and individual end-users. 2) To use POE to assess if a project brief – the programme of requirements, has been met. Conventionally, the building occupants would answer questionnaires, participate in interviews and workshops. A few other tools, considered more objective, are also used as part of POE, such as environmental monitoring, space measurement and cost analysis (Wikipedia 2010). Traditionally POE is carried out by trained professionals or researchers with background in social sciences or workplace consulting.

Recently, researchers have focused on developing methods for usability evaluations for a broader audience. This has partly taken place in the Erabuild-supported project REBUS (User-orientated Benchmarking for Usability and Sustainable Performance of Real Estates) and one of the results is the USEtool from Norway (Hansen et al., 2009). The author group, Blakstad, Olsson, Hansen and Knudsen made a Usability mapping tool, the USEtool, which is targeted to be used by building owners and Facilities Managers. The research was a development process and a case study for three large Norwegian organisations, which can use the resulting toolbox themselves for assessing usability of their portfolio of buildings. The process has five stages. The first stage is an introductory identification stage (investigation of organisational objectives and identify relevant user groups), and a systematic general usability mapping and a walkthrough with more in-depth qualitative studies of specific usability topics. The last stages of the process include comparing findings with objectives, and developing recommendations for improvements in existing buildings or briefing for new facilities (Blakstad et al, 2010). The REBUS projects have also highlighted the evaluation and briefing, as well as support of the project management processes, as the key processes to achieve usability and effective facilities (Blakstad et al., 2010, Jensen, 2010).

3.1.3. Recent research on usability

Apart of static understanding of usability as a quality just to evaluate, we can also understand and use it actively as relationship and interaction between people and buildings.

The following story is an extraordinary example of usability understood as experience of users and relationship and interaction between people and buildings. During the World War II, after the bombing in 1941 of the House of Commons, the prime minister Churchill ordered it “restored in all essentials to its old form, convenience and dignity” (Churchill, 1943), even though it was too small for keeping all the members of the parliament seated. He meant that there were two important messages to send to the world. First message was that the British people would resist and the building is a symbol - “the citadel of British liberty”. Second, that the crowded voting room makes an excellent scene of showing urgency and importance of the matters discussed there. He said at that occasion: “We shape our buildings, and afterwards our buildings shape us” (Churchill, 1943).

Usability is an intriguing challenge for architects, designers and facilities manager as it concerns both how a space is used and the effects of that use. It is an equally challenging concept for managers, because it includes the physical spaces in which an organisation performs its activities. Therefore usability of facilities is a topic exemplifying relationships between what we do, how we do and where we do it (Alexander et al., 2013).

Furthermore, researchers have introduced a concept of *usability of architectural spaces*, which also builds on the trinity of “user - task - physical environment” and selected the main objective and subjective qualities (Bittencourt, Pereira, & Júnior, 2015). The objective qualities are accessibility, readability, orientability, environmental comfort, functionality and safety. The subjective qualities include: familiarity, identity, independence, attachment and satisfaction (Bittencourt et al., 2015).

Furthermore, recent international research points out that *usability* with focus on the user perspective, is an “often neglected aspect of building performance (...) this seems quite odd as most planners, architects and facilities managers will claim that they are strongly concerned about the user perspective and the usability of the workplaces and buildings. The planners and building owners will claim that *functionality* of the workplaces is one of the important success factors for creating a good building. The well-being and satisfaction from the building users are also seen to be very important” (Hansen et al., 2005). From that perspective additional research in methods to improve usability focus in the design processes is of high value to all parties involved.

Well-being has got attention in 2016, as *the Guardian* announced, that “sustainable, profitable green buildings will no longer be enough to stand out. Buildings will also be expected to directly contribute to the health and wellbeing of the people who live, work and learn inside them. For buildings, healthy will become the new green” (Fedrizzi, 2016).

Recent research proposes the combination of *usability* and *user involvement*. Alexander suggests that in order to improve usability, “users must be empowered and (...) offered the

opportunity of meaningful involvement”. He argues that conventional appraisal methodologies are focusing too much “on the building as a subject and take functional perspective, rather than (...) on the effect of the environment on users”. User participation is limited in those processes and the potential for user empowerment is ignored. There is a need for change of perspective, “from building and its production, to users and the community” (Alexander, 2010).

In Paper 2 usability research is divided to 3 groups:

- Usability engineering (prototype testing of consumer products)
- Usability and accessibility (design for disability, universal and inclusive design)
- Usability appraisal (evaluation and feedforward, requirements and exploration of possibilities)

Furthermore, the overview of user oriented research and usability is presented in Table 2 and Paper 2.

3.1.4. New concept of Usability Briefing

As described in Paper 1, if *Usability* of future buildings shall be improved in general, there should also be focus on Usability in preliminary design phases for facilities and *briefing* for new built environments. It is also in the early design phases where the user involvement can change much of the programme to improve the future usability and where changes are of low cost for the whole project.

I will introduce the concept of *Usability Briefing* in section 3.3.3. The concept will be unfolded in a new *Usability Briefing Process Model*, which is described in Chapter 5 USABILITY BRIEFING PROCESS MODEL and Paper 5.

3.2. USER INVOLVEMENT AND USER DRIVEN INNOVATION

3.2.1. Overview of understandings and methods of User Involvement in design

In recent years there has been growth and exploration of different approaches to design research. As some of them are complementary and others competing, the result was chaotic and confusing. I presented a visual map in Paper 2, adapted from research publications of (E. B. Sanders, 2006; E. B.-N. Sanders & Chan, 2007), which organises the landscape of design research and many of the approaches to user involvement, see

Figure 9.

The different approaches are positioned in the framework with two axes. The vertical axis is stretching from **Design-led** to **Research-led**, while the horizontal axis is stretching from an expert mind-set, where users are informants and design is **FOR people**, to a participatory mind-set, where users are co-creators and design is made **WITH people or BY people**.

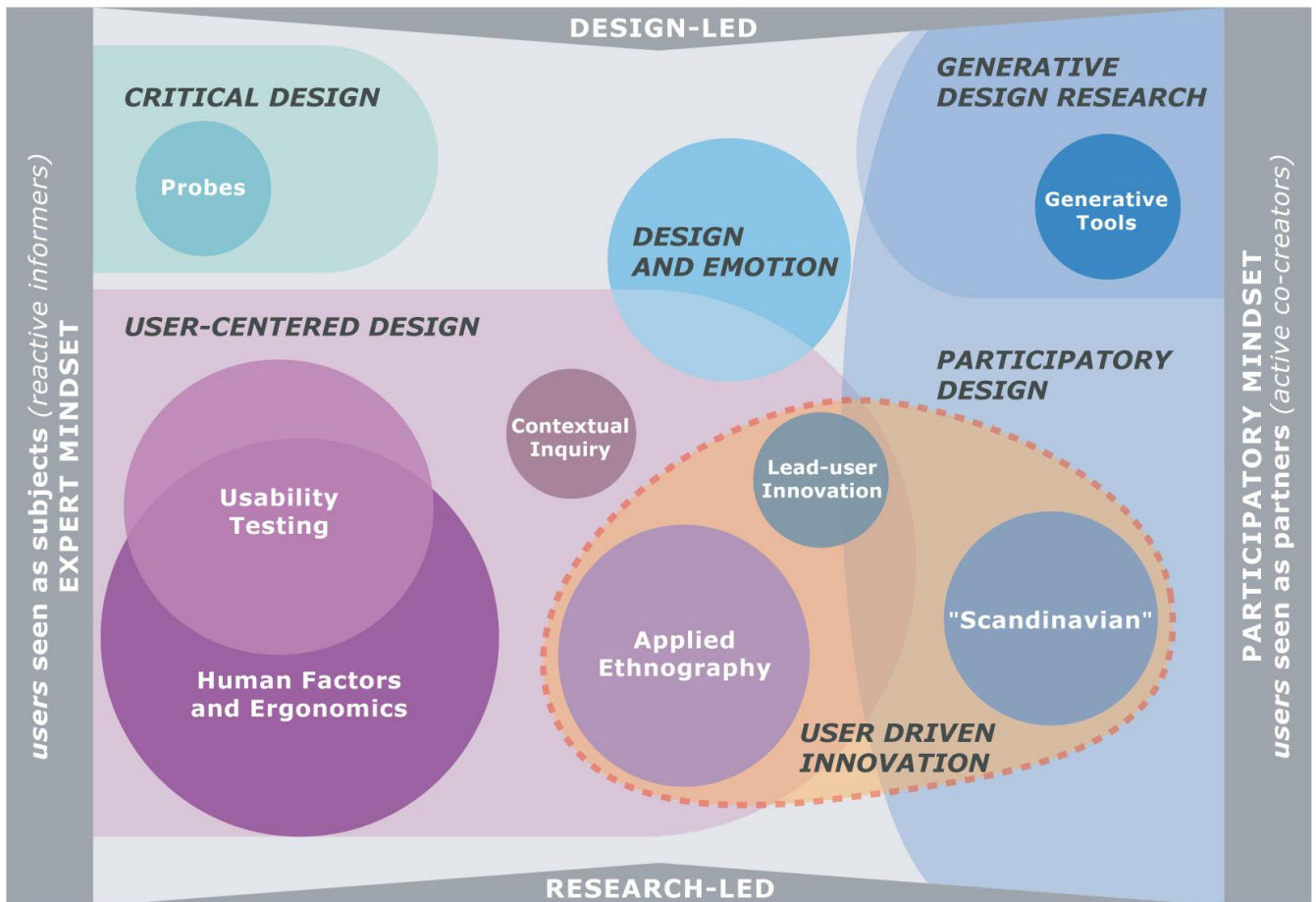


Figure 9 Emerging trends in design research. Adapted from Paper 2 – (Jensen et. al, 2011; Sanders, 2006)

The largest area on the map (

Figure 9) is covered by the *User-centered design*, which is most developed according to Sanders and Chan, and aims at developing products and services to better meet the needs of users. The approach is research-led with expert mind-set. The main methods are *Human factors and ergonomics*, *Usability testing* and *Applied ethnography* (Paper 2).

Another large zone is *Participatory design*, which can be both design-led and research-led, and actively involves users throughout the design development. The origins date back to trade union movements in Scandinavia in the 1960s and later spread to other fields. For example the new trend was noticed in software design by Floyd et al. (Floyd, Mehl, Resin, Schmidt, & Wolf, 1989), who described a couple of main characteristics of the new *Scandinavian approach*; see section 3.2.3. The most important was the cooperation between developers and users, considered to be a crucial factor and getting

methodological support. Furthermore, various forms of prototyping were used to provide mutual learning. Users were getting help to progressively qualify themselves for the process. In addition to this two crucial principles were found - mutual learning and designing by doing (Paper 2).

Mutual learning, also called co-learning means, that both users and developers are reliant on the mutual process of learning and communicating. *Designing by doing* means that experimentation and testing takes place already in early stages of a project, such as using fast prototyping and promoting communication and learning processes. Last, but not least there arrived a new concept of *Co-creation*. Examples of the collective process, communication and co-creation of workplaces are described by (Granath, 1998). Moreover, (Sanders & Chan, 2007) add another characteristic to *participatory design* – the use of physical artefacts as thinking tools throughout the design process. Those tools - *Boundary Objects* - have been explored by researchers (Clarke and Fujimura, 1992; Granath, 1998); Kjølle and Gustafsson, 2010). Recent examples of research on participatory design, with comparisons of multiple methods for user involvement are: (Broberg 2009, 2010; Binder and Brandt, 2008; Peek and Geurts, 2010; Våland, 2010; Storvang, 2012).

Lead-user innovation (von Hippel, 2005), is located in the map as a small overlap between *User-centred design* and *Participatory design*. If the definition of *User driven innovation* is broadened, as by the Danish Enterprise and Construction Authority (2010), then the overlap is covering the *Scandinavian participatory design* and *Applied ethnography* as well, as I have indicated by the dotted line and orange background in

Figure 9 (Paper 2).

Three other design categories described by Sanders & Chan (E. B.-N. Sanders & Chan, 2007) are worth mentioning: *Affirmative design*, *Critical design* and *Generative Design*.

Affirmative design, according to (Dunne & Raby, 2001), reinforces how things are now, conforms the expectations and is the most used in design. Critical design rejects how things are now and provides alternatives to design and values. Generative design, on the other hand, focuses on creating tools for non-designers and empowering them to express their dreams for the future or make their own alternatives to the current situation. Generative design is a part of the Participatory design zone, and is design-led (Paper 2).

It seems like there is a strong development of research in the border area between *User-centred design* and *Participatory design*. Further research could explore the boundaries and the growing overlap of the two zones, as well as particular effects on specific fields, like the built environment, architecture and design (Paper 2).

A similar, but more straightforward grouping of the methods was developed by Storvang (Storvang, 2012) according to how the methods approach and process the user needs, see Figure 10.

LITERATURE STUDY

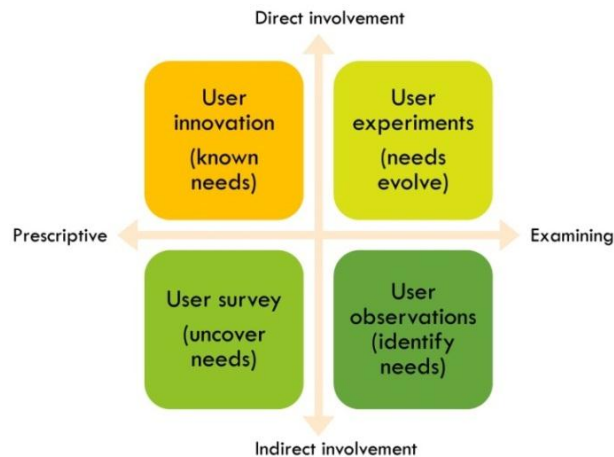


Figure 10 User involvement and processing needs, adapted from (Storvang, 2012)

3.2.2. User driven innovation

This section is based on Papers 1, 2, 3 and 5.

According to von Hippel (von Hippel, 2005), innovation is nowadays being democratized, and it is no longer just manufacturers, but users of products and services that are innovating. In the traditional, manufacturer-centric model of innovation, the users' role is to have needs and the producer's role is to identify them and satisfy them by new products. In a user-centric model, manufacturers invite lead users for usability testing and simulations, where the advanced users can find additional improvements for developing the next prototypes. Furthermore, he claims that most innovating users have characteristics of lead users - they are ahead of the majority of users in their populations with respect to an important market trend.

Ehn & Kyng (Ehn & Kyng, 1987; Kyng, 2010) define *user driven innovation* as introducing a ground breaking change - now innovation and design is not done "with" nor "for" users, but "by" users! In the recent years, we have seen in some fields that it is truly the users, who are first to develop new consumer products, as the computer software and communication possibilities are steadily growing, resulting in user-centric or user driven innovation (von Hippel, 2005).

Table 2 User driven innovation methods, Danish Enterprise and Construction Authority (2010),

User driven innovation methods	
Lead user approach	First mentioned by von Hippel, lead users – advanced users, are gathered with the project team at workshops, make rapid prototyping, then R&D department develops the product further
Ethnographical approach	The aim is to find the needs, both known and tacit, by studying the users in their everyday situations, the used tools can be: observations, workshops, interviews
Participatory design /innovation	The users are co-designers, methods can vary and are chosen to fit the exact project

Recent research in the Nordic region defines user driven innovation as “the process in which knowledge is being retrieved from users to develop new products, services and concepts. A user-driven innovation process is based on an understanding of user needs and a systematic involvement of users” (Rosted, 2005; Wise and Høgenhaven, 2008) also stress the systematic involvement.

According to the Danish Enterprise and Construction Authority (2010), user driven innovation methods can be divided into three groups, see Table 2.

Research in user driven innovation has had a strong focus on products and software. As innovation by users is predicted to grow in the society (von Hippel, 2005), it is worth further examining the possibilities of and experiences with user driven innovation in the building sector. Furthermore, the different methods of user participation and involvement like workshops, rapid prototyping, simulations, interviews and observations can be applied in the process of user driven innovation and tested further in different stages of the design process.

3.2.3. Lead users – von Hippel

Von Hippel (von Hippel, 2005) argues that user-centered innovation processes offer great advantages over the traditional manufacturer-centric innovation development, where the users rely on their imperfect agents. In addition to this, the individual users do not have to develop everything they need on their own, but can benefit from innovations developed and freely shared by others (Paper 1 and 3).

Furthermore, von Hippel introduced the concept of *lead users*. They are those users, who are ahead of the majority of users in their populations with respect to an important market trend, and they expect to gain relatively high benefits from a solution to their needs. Studies have shown that most innovating users have those characteristics, no matter if they are individuals or companies (von Hippel, 2005).

As mentioned in the previous sections, traditionally manufactures develop and innovate by themselves and use patents and copyrights to protect their business. In this manufacturer-centric model of innovation, the users’ role is only to have needs and it is the producer’s role to try to identify them and satisfy them by new products. In addition to that, manufactures invite the lead users for usability testing, where the advanced users can find additional improvements for developing the next prototypes. Generally speaking, it is the “users, who have a more accurate and more detailed model of their needs than manufacturers have, while manufacturers have a better model of the solution approach in which they specialize” (von Hippel, 2005).

Users’ needs were important to computer software development since the 1960’s. A research group at Stockholm business school developed ISAC - a method that starts by considering the needs, problems, and ideas of the users, proceeding immediately to the specification of manual activities and computer programs (Floyd et al., 1989).

Already in 1989 Floyd et al. (Floyd et al., 1989) noticed a new trend of *User involvement* in software design and described it in the article *Out of Scandinavia: Alternative approaches to Software Design and Systems*. There were a couple of main characteristics of the new Scandinavian approach. The most important was the cooperation between developers and users, considered a crucial factor and getting methodological support. Furthermore various forms of prototyping were used to provide technical support for the process of mutual learning. The users were getting (Suchman, 1988) help to progressively qualify themselves for the process. The main goal was to adapt software to meet the needs of specific user communities. In addition to this the traditional participation approaches were extended by adoption of the two principles - mutual learning and designing by doing. The *mutual learning*, also called *co-learning* means, that both users and developers are reliant on a mutual process of learning and communicating. The *designing by doing* means that there was experimentation and testing already in early stages, such as using prototyping and promoting communication and learning processes. Last, but not least a new concept arrived, that revolutionised the *User involvement* methods – the concept of *Co-creation* with design made “by” users (Ehn & Kyng, 1987). See also Paper 1, 2, 3. The (Björgvinsson, Ehn, & Hillgren, 2012) surprising empirical finding in *user driven innovation* is that users often freely reveal their innovations. The practices visible in “open source software development were important in bringing this phenomenon to general awareness” (von Hippel, 2005).

The recent shift to *User driven innovation* has very attractive qualities, described by von Hippel:

- the users easily get precisely what they want by designing it for themselves
- the innovation by users increases social welfare

Nevertheless there are some challenges to obtain a widespread *User driven innovation*. The manufactures must be able to apply the needed fundamental changes. Moreover, the governmental policy and legislation should stop supporting the manufacturers-innovation only (von Hippel, 2005). Furthermore, von Hippel states that “Users’ ability to innovate is improving *radically* and *rapidly*” and he predicts, that innovation by users will continue to grow, even if both users and manufactures have a constant willingness to invest in obtaining a precisely right product (von Hippel, 2005).

3.2.4. Boundary objects – tools, methods in user involvement sessions

The concept of *boundary objects (BO)* is described as problem solving by means of translation (Star & Griesemer, 1989) and are studied in Paper 3 and 5. Boundary objects are also referred to as media of communication between communities. They can be abstract or concrete objects that arise over time from durable cooperation and understood or misunderstood in equality between the participants. The concept has been described further by several researchers, e.g. (Clarke and Fujimura, 1992) define boundary objects as including things, tools, artefacts and techniques, in addition to ideas, stories and memories of community members. Several researchers, e.g. (Kjølle and Gustafsson, 2010; Carlie, 2002, 2004; Wenger, 2000; Broberg et al., 2011) have been studying the use of BO in

literature reviews and case studies of briefing and design processes or product development, and concluded, that BO can be divided into the following categories:

- Repositories (i.e. cost databases, parts libraries),
- Standardised forms and methods (i.e. drawings, handmade sketches, lists of problems, questionnaires),
- Objects, models and maps (i.e. slideshow, CAD 2D-3D, fishbone chart, mock-ups),
- Discourses (i.e. questioning situation, typical action situation),
- Processes (i.e. prototyping, visiting other departments)

In addition to that, (Broberg, Andersen, & Seim, 2011) made a list of characteristics of boundary objects. The 4 most relevant for this case analysis are the following:

- BO are not ready made, but *objects-in-the-making*, need to be created by participants
- BO have *built-in affordances*, possibilities for action, interaction instruments
- A *facilitator* of the events selects the BO, develops rules and instructions and guides the workshops
- BO are used in discrete events, workshops with a *temporary learning space*, enable a collaborative design process, enable participants into “design mode”

Several other publications on boundary objects include (Boujut and Blanco, 2003; Vinck et al. 1996; Wenger, 2000).

In this PhD thesis and papers I use the concept of boundary objects in an understanding of different tools and objects used in workshops. My criteria for analysing and evaluating results with BO are the following: First, how well do they help communication and innovation? Are they easy to use and understand for all participants? Are they bringing new ideas? Second, what is the effect of BO on design solutions?

In a publication on transforming organisational and technological boundaries (Bødker, Kristensen, Nielsen, & Sperschneider, 2003) the authors use artefacts (not called boundary objects here), to evaluate design scenarios and identify and move boundaries in organisational worlds. The examples of the BO artefacts were: cultural probes with photo diary, prototyping, workshops, ethnographic field studies and situated interviews. It is an interesting study of the boundary objects being used to explore the boundaries.

3.2.5. User involvement methods

There are several methods and boundary tools for user involvement mentioned in literature. Many of them are described and compared in literature (Binder and Brandt, 2008; Storvang, 2012). I present an adapted and shortened list in Table 3 of some key tools that are used in the hospital projects and are described in the case studies in chapter 4 EMPIRICAL STUDIES. A few of the tools are also described in section 3.5.5 Participatory design and co-creation with users.

3.2.6. Usability and user driven innovation – unity or clash?

As described in previous sections and Paper 1, the concepts of *Usability* and *User driven innovation* have several common features and benefits. The recent understandings of the two concepts are summarised below.

Usability of the built environment, as described in section 3.1 is a quality of a building consisting of four elements: 1) Support and shelter the users, while they are performing their activities, 2) Contribution to efficiency, effectiveness and satisfaction in the user organisations, 3) Dependence on context, culture, situation, experience, 4) Assessed by subjective view of users (unlike functionality)

Table 3 Key tools for user involvement in built environment, adapted from Storvang 2012

Usability tools	User driven innovation tools
Benchmarking	Brainstorming
Desk research	Design games
Flow analysis	Design Lab
Focus groups	Dialogue
Functional analysis	Drawing
Human factors i.e. Critical Incident Study	Idea development and co-creation
Interviews	Lead users
Market analysis	Mind mapping
Observations	Mock-up
Occupancy studies	Model tests, Mock-ups
Personas	Narratives, Storytelling
Photographs	Observations
Registers, recording of data	Picture diagrams, associations, cards
Statistics	Prioritising
Survey	Rapid prototyping
Video recording	Role playing
	Scenarios
	Simulation
	User meetings
	Video recording and discussions
	Virtual reality
	Walk through evaluations (USE tool, POE) and discussions,
	Workshops

User driven innovation in the built environment is one of the methods of user involvement that can be used in planning new facilities or improving existing ones. Its main characteristics are that 1) users have the most accurate understanding of their needs, 2) users are actively involved already at early phases, 3) there is co-learning and co-creation between the users and the designers (the participatory innovation), 4) democratised design process improves social welfare (Paper 1).

The question asked in Paper 1 was *to what extent*, and *how* users can be involved in design processes to create better and innovative buildings of enhanced usability and if the concepts of *Usability* and *User driven innovation* are in “unity” or “clash”.

I described in Paper 1, that there are more similarities of the two concepts and therefore there is a unity, rather than clash of them, but it depends on the particular understanding of the field. From one point of view, some fields would consider the *Usability* and *User driven innovation* as two clashing concepts, or that one – *Usability (tests)* is an older method that has been made redundant by a newer method - *User driven innovation*. For example in product development there has been a shift away from the type of user involvement in the middle or end of the development process, where the users could give feedback on the usability of the product prototype and the result would most often be a development of a new prototype by the professionals. The new and more used method is *User driven innovation*, where the product is co-created by the users and designers together, and the process runs already at early stages of product development. Therefore *User driven innovation* leads to the situation, where there is no need to develop several finished prototypes, which must be tested and improved in several *Usability Tests*, because the developed product is co-created to fulfil the needs from the start. Those two understandings are indeed clashing.

On the other hand, there is an important fact, that the built environment is, unlike industrial products, not developed as a prototype, which can be mass produced afterwards. Instead of that, each building is custom made, a prototype which is never repeated. Nevertheless, there is one exception - the standardised type family houses. Therefore in general, it means that the *Usability* of buildings cannot be understood as *usability tests* leading to more prototypes, but as a quality of a building.

Furthermore, it is easy to see the similarities in the two concepts. First of all, both concepts rely on the users and involve them. *Usability* can only be assessed with users, who can subjectively describe how well the facilities support their activities, and what are their experiences. *User driven innovation* can only occur with the active role of users in co-designing and innovating. The conclusion could be that ***User driven innovation* is one of the user involvement methods to achieve a better *Usability* of facilities.**

Additionally, there are a number of user involvement methods and they all might be used for planning new buildings. If the aim for the involvement is better usability, most of them can be used, but achieving better usability might depend on how strong the usability focus of the design team is and type of user involvement. *Usability* evaluations like POE – Post Occupancy Evaluations can be one of the tools. In the traditional understanding those tools would be used to evaluate existing buildings in use and possible make small improvements. *User driven innovation*, as a method of user involvement, can be used from the beginning of the process of planning a new facility. In this method the focus is on satisfying the users' needs, innovation and co-learning and co-designing with the professional design team. The chances of *Usability* focus in the process of *User driven innovation* are even higher than in other user involvement methods.

However, *Usability* evaluations of buildings, like POE can potentially also be used in planning and briefing for new facilities. That thought comes from the common belief that users can and perhaps should be involved in much earlier stages of project development and in a much broader extent than traditionally in the building sector. One of the possible ways to achieve that is to make *Usability evaluations* at early design phases, in cooperation between the design team and users of buildings in use, which are similar to the planned ones. In that way co-learning can occur and there can be achieved a deeper understanding of users' needs and possibilities. The claim is that this would result in a better usability of the built environment (Paper 1).

Finally, as described in Paper 1, it can be concluded that even though the two concepts may seem to clash in some professional fields, we can see that understanding them as "unity" is potentially of great value to the built environment, which would result in being more usable and innovative. *User driven innovation* is one of the user involvement methods that easily approaches the task of planning a facility with a focus on *usability* and users' satisfaction and therefore is closest to *Usability*. Furthermore, *Usability evaluations*, when used in briefing and planning new facilities together with users, can further strengthen the cooperation and co-creation of the design team and users as well as potentially the focus on *Usability* of the entire design process. This unity of the concepts might be the ultimate step towards better usability of the built environment in the future.

3.3. BRIEFING - ARCHITECTURAL PROGRAMMING

3.3.1. Briefing - research and practice

Briefing, also called architectural programming in some countries, is usually understood as one of the first phases of a building project, before the design activities start (Paper 2 and 5). Guidelines in UK, USA and Denmark (RIBA, 2013; DANSKE ARK/ FRI, 2012; AIA, 2007), name it as the first or second phase of a building project; see the list of building phases described in section 3.5.1.

The traditional view is that briefing takes place before the design starts and the resulting briefing documents should contain the client's requirements for the building design. The brief is usually written by experts. Users are mainly involved as data sources, for instance via interviews and meetings with the experts.

Briefing is a process that in practice often results in briefing documents (the brief, or the program of requirements) that contains the client's requirements for the building. When finished, the document is handed over to the design team who is then expected to translate it into a design proposal. This rather static, document based understanding of briefing has been labelled as traditional and is challenged by several researchers. Their suggestions for change can be grouped into two views: 1) Briefing should be dynamic (Nutt, 1993, Prins et al., 2006). 2) Briefing should be a continuous process (Barrett and Stanley, 1999, Blyth and Worthington, 2001, Fristedt and Ryd, 2004, Voordt and Wegen, 2005, Jensen, 2006 and Jensen et al., 2011).

Furthermore, it is suggested in literature that there is no such thing as the brief, but several different briefs with different purposes. For example, Nutt (Nutt, 1993) proposes the need for a strategic brief and a facilities management brief. Likewise, Fristedt and Ryd (Fristedt and Ryd, 2004) compliment the strategic brief in the pre-project phase with a tactical brief in the design phase and an operative brief for the construction phase. The different briefs in different building phases were shown in a model by (Blyth & Worthington, 2001, 2010). Figure 11 shows the adapted model, where three brief types - most often directly mentioned by researchers, were marked: 1- *strategic brief* in the pre-project phase, 2 – *functional brief* at the beginning of the project and design phases, and 3 – *detailed brief* in the technical design phase.

The important role of briefing on the final result of built environment was stressed in various publications, for example by (Barrett and Stanley, 1999; (Blyth & Worthington, 2001, 2010); Jensen and Petersen, 2009) and the previously mentioned REBUS project (Blakstad et al, 2010).

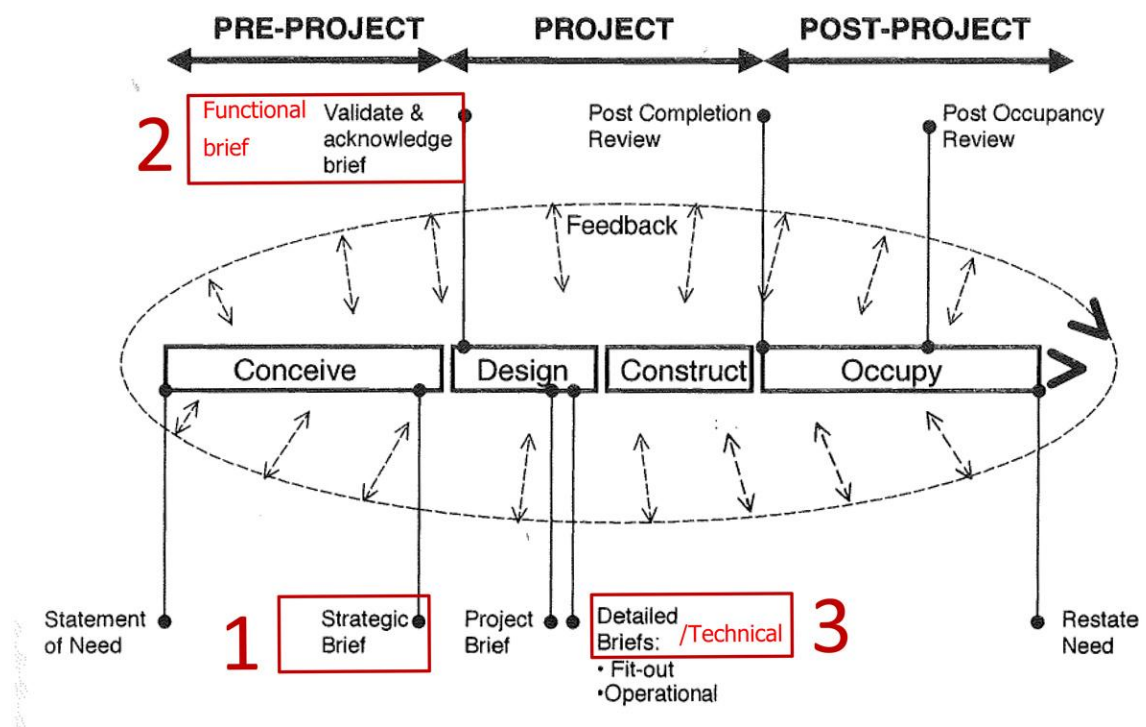


Figure 11 Different briefs in different building phases, adapted from (Blyth & Worthington, 2001, 2010)

The recommendations by (Bogers, Meel, & Voordt, 2008) to the briefing documents are to:

- Give architects opportunity to comment on the brief
- Check consistency and completeness of the brief
- Be clear about the essence and priorities of the project, briefing is a process of refinement
- Be clear about the status of requirements, which are fixed or flexible

- Focus on the unique or specific requirements of the project, how the building is different from standard
- Include the “soft” information about the culture, ambitions, desires of the clients and users, business processes, scenarios, descriptions of daily situations

Even though briefing is considered crucial for the successful delivery of construction projects, the current briefing practices are considered inadequate by many researchers and many problems in building projects can be traced back to briefing (Yu, Shen, Kelly, & Hunter, 2008).

3.3.2. Briefing and user involvement

User involvement is often seen as a critical activity to ensure that briefs reflect the needs, requirements and wishes of the future users of the building. Jensen and Pedersen (2009), for example, express the need for ‘inclusive briefing’– an interactive process, where the demand and supply sides are involved in a mutual dialogue process. (Prins et al., 2006) address a need for feedback to, and dialogue with, all stakeholders. Paper 2 (Jensen et al., 2011) suggests a guided learning and dialogue process with client and user representatives that actively involve users, especially if work flows and processes change in part of an organization. Furthermore, briefing concerns all the clients’ and user needs in developing a facility and it is a continuing process with changing focus in different phases (Paper 2). Jensen (Jensen, 2006) identified the following reasons as the most important for involving users in the briefing process:

- Ensure that new facilities are designed in accordance with the needs and intentions of the organisation
- Learn from good and bad experiences with existing facilities
- Ensure acceptance and appreciation of the new facilities among managers and staff(Paper 2)

Yu et al. 2008 listed thirteen variables that have impact on the briefing process, many of them considering the involvement of different stakeholders. The variables and their main characteristics are summarised as follows:

1. Project - a change needing a comprehensive definition
2. Stakeholder management - identify all types of stakeholders, consider their interests, devote time and effort
3. Teams and team dynamics - focused and interacting
4. Client representation – ensure adequate representation of decision making units
5. Change management – client aware of impact of change, clear project information, appropriate stakeholder information incorporated at a particular stage
6. Knowledge management – teamwork, collaboration, face to face contact
7. Risk and conflict management – preventive and reactive problem solving plans
8. Post Occupancy Evaluation and Post Project Evaluation – past experiences inform better decision making, consultation with Facility Managers and end users benefit the briefing process

9. Critical Success Factors and Key Performance Indicators – clear objectives and requirements, time, cost, quality and also satisfaction of stakeholders
10. Types of business and organisational theory – different success criteria for different types of organisation
11. Decision making – effective decision making, more methods
12. Communications – the most important factor, active listening, complete flow of information between all parties
13. Culture and ethics – influence of culture, ethics and decisions

3.3.3. Traditional briefing and usability briefing

The importance of briefing on the final result of built environment has been stressed in various publications, for example by (Barrett and Stanley, 1999; Blyth and Worthington, 2001; Jensen and Pedersen, 2009) and the REBUS project (Blakstad et al., 2010). The recent work by CIB W111 (Alexander, 2010) on usability has also highlighted the importance of briefing as means to achieve usability.

In Paper 2 we developed the idea further and introduced the idea of '*usability briefing*', and showed a need for further research in briefing and the role of the users in the briefing process and how to manage inclusive and continuous briefing with user involvement, as well as research that evaluates the effects of user involvement for different types of users, processes and facilities.

Table 4 Comparison of traditional and usability briefing. Revised and adapted from Paper 2 - Jensen et al. (2011) and Paper 5 - Fronczek-Munter (2015), and Jensen and Pedersen (2009)

Traditional briefing	Usability briefing
Concerns new building project	Concerns client and user needs in existing or future facilities
A definite phase at an initial stage of building project	A continuous process with changing focus in all phases of building life cycle including design, construction and in use
An expert based information collection	A co-learning and dialogue process with users
User opinions mainly used as data source	Users actively involved as co-designers and part of a corporate change process
The result is a brief, i.e. a requirement specification	Continuous collection of visions and requirement specifications, with changing detail and focus in all phases

This PhD thesis and Paper 5 address the suggestions made by researchers and in Paper 2. The comparison of the characteristics of traditional and usability briefing is presented in Table 4. The main characteristics of usability briefing are following: it concerns existing or future facilities, the process is continuous in all phases, with changing focus; users are actively involved and are co-learning and co-designing. The results of the PhD research are

presented in EMPIRICAL STUDIES, in chapter 4 and synthesised in a new Usability Briefing process model in chapter 5 USABILITY BRIEFING PROCESS MODEL.

3.4. EVALUATION METHODS FOR FACILITIES AND THE “FLOWER” MODEL

There are various methods and tools for evaluating facilities. The focus is usually on the technical building performance, function/usability or form/beauty. Examples are: Post-Occupancy Evaluation (POE) and Usability Appraisal. Nevertheless, evaluations of buildings in use are rare. They are considered a long and expensive part of the final phase of a building project. Therefore the experiences of finished building projects are not collected and mistakes are repeated (Paper 4).

The following sections and paper 4 list different types of evaluation methods, ordered according to focus areas and a proposition of specific evaluation methods in different building phases of healthcare facilities. Hospital evaluations with experts and users are also considered; their subjective view on space, function, technology, usability and aesthetics. Section 3.4.1 starts with reflections and a model of different reasons for evaluations. Section 3.4.2 presents a literature review on POE. Section 3.4.3 presents a new visual model, the Evaluation Focus Flower, for sorting various methods according to focus area. Section 3.4.4 presents a table structuring and grouping various evaluation methods; see the summary in Table 5 and the full table in Paper 4, p. 5-8. Section 3.4.5 presents an additional model, which proposes which evaluation methods are suitable for various aims and building phases of a hospital building project, i.e. which is giving best input for the initial briefing process of new hospital facilities with ambition of creating buildings with enhanced usability.

3.4.1. Exploration of evaluation methods - reasons and choice of methods

Several reasons exist for making evaluations. Cold (Cold, 2012) divides them under 3 groups:

- Recognition - To understand the place and yourself, experience, understanding, development of theories
- Control - To see others' experience and use of place, control and get abilities/knowledge
- Professional information - To know expert evaluations, discuss and inform

The British Council for Offices (British Council for Offices, 2007) suggests two main purposes for a Post Occupancy Evaluation (POE). The main aim is to gain feedback on how successful the workplace is in supporting the occupying organisation and individual end-users. The other purpose is to use POE to assess if a project brief – the programme of requirements, was met.

Researchers recently presented additional aims of making a POE - to gain knowledge from own and other sites and feed forward for new briefing processes (Jensen, 2010; Preiser, 2010; Lindahl, Hansen and Alexander, 2012). This use of POE methods for new building projects is called Pre Design Evaluation (PDE) (Ornstein and Andrade, 2012; Preiser and Vischer, 2005).

In Paper 4, I recommend combining POE / PDE with user involvement and co-learning, making a common understanding in the participant group.

A model combining those aspects is presented in Paper 4; see Figure 12, and shows various reasons for evaluations of buildings. The model has two axes. The horizontal axis is inspired by innovation thinking and shows the amount of action and innovation level in the building. The vertical axis adds the context:

- Existing building, (either testing current existing conditions, or knowledge applied for improvements or radical innovation in same facility)
- New building, (testing if requirements are met, learning from other existing facilities and feed forward for briefing and innovation in a new building, part of user involvement and co-learning process)
- Develop generic knowledge (documentation of best practice case in specific type of building or geographical area, inspiration to innovation – many cases)

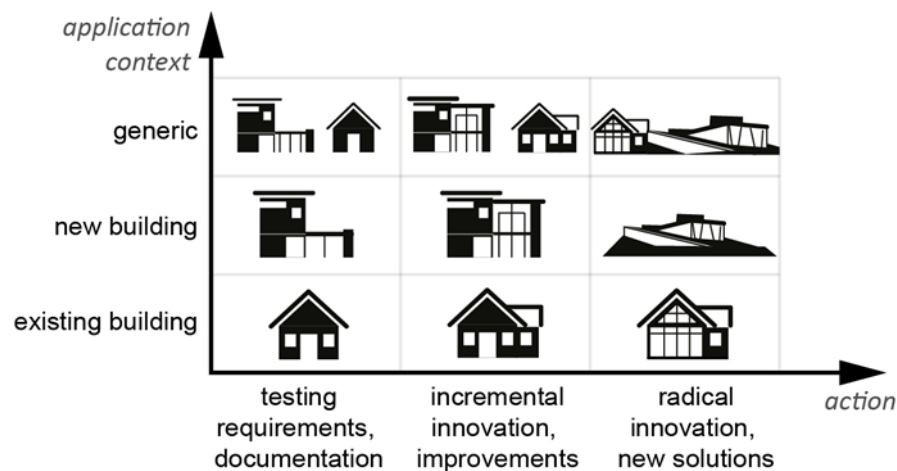


Figure 12 Model of the various reasons for evaluations of buildings (Paper 4)

Similar to choosing the methods of user involvement, which I recommend to choose carefully to fit the expected focus and type of result (Paper 3), I also recommend to be aware of an organisation's motivation for doing evaluations and in advance choose the focus areas and methods to support the aims.

Once the goals of the evaluation are clear, a suitable method can be chosen. In order to assist that process I have organised the different methods from literature review in Table 5. Additionally, I have developed a new Evaluation Focus Flower model; see Figure 13, for an easy overview of methods and their main focus. The POE method is described in section

3.4.2 in two understandings: the traditional common practice and a broader “umbrella” understanding, in which all the further methods can be used.

3.4.2. Post Occupancy Evaluation (POE)

The most known evaluation method for buildings is Post Occupancy Evaluation (POE) (Preiser, 1988, 1995, 2003, 2005). For clarity I need to add, that POE is also the abbreviation for *Panel of Experts* and *Power over Ethernet*, two other well-known terms that are not the same. ‘Post occupancy’ refers here to the fact that the building is already taken into use at the point of evaluation. The origins of the method are in the USA and it has been used since the 1960s. According to the definition of Preiser et al. (Preiser et al., 1988, 2005), POE is "the process of evaluating buildings in a systematic and rigorous manner after they have been built and occupied for some time".

There are 3 levels of detail in POE, (Preiser, 1995, 1988, 2003; Blakstad, 2008):

- **Indicative** - quick, walk-through evaluations, involving structured interviews with key personnel, group meetings with end-users, inspections. Result is a quick overview of positive and negative aspects of building performance, gained with limited use of resources
- **Investigative** - in-depth evaluations, interviews and survey questionnaires, photographic/video recordings, physical measurements, benchmarking with literature and state of the art facilities. Result is in depth evaluation of the facility
- **Diagnostic** - longitudinal and cross-sectional evaluation studies of performance aspects, comprehensive, many variables, research approach. The result is knowledge from state of the art descriptions from cases.

The POE approaches have evolved from case studies of stand-alone building projects, to structured studies of varied building forms with valid, cross functional results for benchmarking (National Research Council, 1987). The critique of traditional POE was that it usually focuses on technical building performance. Nowadays the term for such technical focused assessments is commissioning. Jensen (Jensen, 2010) proposes, that evaluation of usability complements commissioning activities in a combined validation of both the technical and the user oriented performance of buildings, and that the processes could run continuously, like the continuous briefing (Jensen et al., 2009), but with different peak times. Riley et al. (Riley, 2003) present the historical development of POE, also previous resistance to POE by construction professionals. Preiser (Preiser, 2010) recently states that POE /PDE is a proactive process which feeds into the next building cycle through strategic planning/ needs analysis and programming/briefing. The broad understanding of POE, is that it evaluates the performance of the building based on user experiences, but also considers a more holistic, process-oriented evaluation (Preiser and Vischer, 2005). The clients are interested in POE to improve their facilities and occupants’ performance (B. Bordass & Leaman, 2005b).

POE practitioners are usually architects, but according to Preiser (Preiser, 2010) they will be trained in several other disciplines in the future, also in social sciences/management.

Nevertheless other kinds of participants can run POE or PDE: managers and design team with user groups, personnel and end-users.

3.4.3. Overview of the visual model with evaluation methods

There are over 150 POE techniques available worldwide (McDougall et al., 2002; Leaman, 2003; Bruhns, Bordass, Leaman, 2005; Blakstad, Hansen, Knudsen, 2008; Riley et al. 2009; Haron, Hamid, 2011; (Siri H Blakstad et al., 2008; Siri. H. Blakstad, Hansen, & Knudsen, 2009; B. Bordass, Leaman, & Cohen, 2002; B. Bordass & Leaman, 2005a; W. Bordass & Leaman, 1997a, 1997b; Cohen, Standeven, Bordass, & Leaman, 2001; Stevenson & Leaman, 2010). Some are well established, for example: Mental Map (Lynch, 1960), Save (1990). Other methods are more recent: USEtool (Siri. H. Blakstad et al., 2009). Some of the different methods of evaluation are presented in Figure 13 and Table 5 with typical focus areas. (Paper 4)

Figure 13 provides an overview of the methods, grouped and placed on the “Evaluation Focus Flower” model in order to easily find the right evaluation method fitting the focus area to study. The many focus areas are represented by flower petals with overlaps. The model background is built on three main areas, that are based on three qualities of architecture that were defined in Ancient Rome by Vitruvius (80-15 BC) in his book “De architectura”, as mentioned in section 3.1.1. In this PhD thesis Venustas will be translated as Beauty/Form, Utilitas - as Utility/Usability and Firmitas - as Durability/Technology, as shown previously on Figure 7.

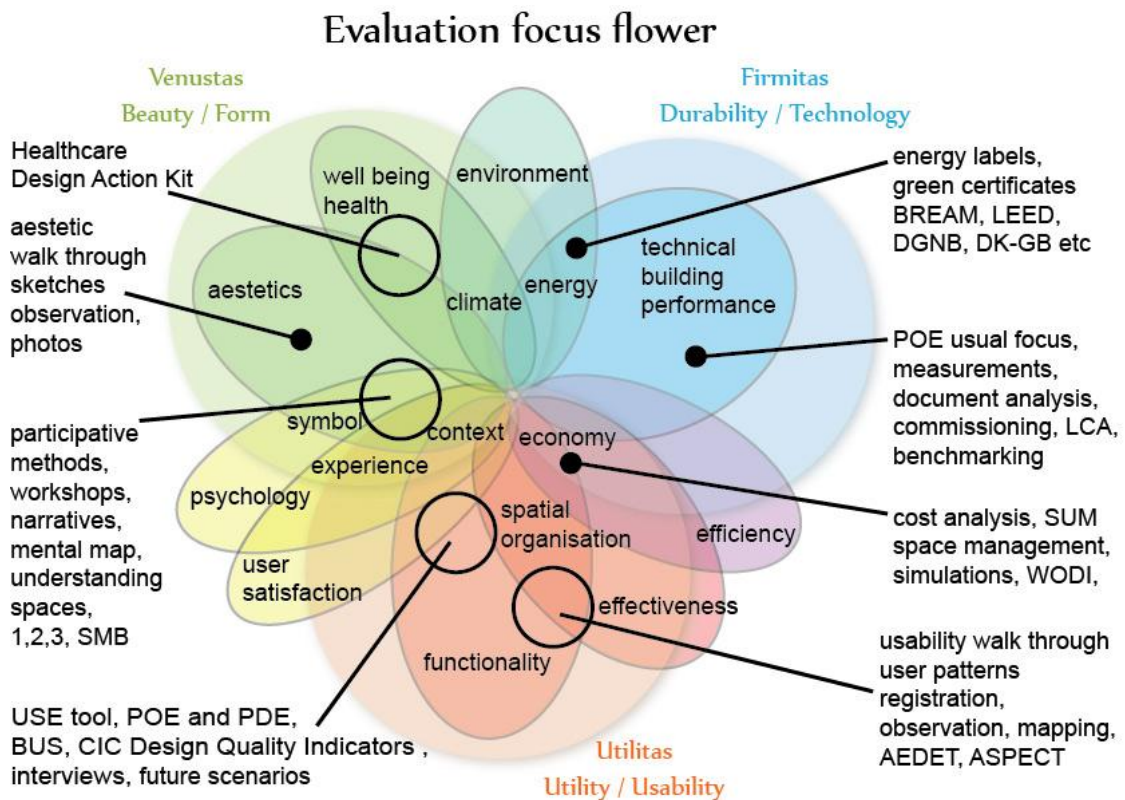


Figure 13 Evaluation Focus Flower model with a few evaluation methods placed accordingly to their main focus (Paper 4)

3.4.4. Methods of building evaluations depending on focus

In Table 5 different methods for building evaluations are summarized, the methods are grouped depending on focus and shortly explained. Furthermore, generic methods that can be used with various focus areas are also listed. The three remaining groups are the Vitruvian three: Beauty, Usability and Technology. The full table with more information to each method and its focus, as well as all references is available in Paper 4.

Table 5 Summary of different methods of building evaluation, their main tools and focus. See the full table with more details and references in Paper 4.

Method	Summary of tools and focus
Generic methods	
Benchmarking, BRE Design Quality Method (DQM), Document analysis, Interviews, Learning from experience , Observation, documentation, photographs, Overall Liking Score, Participatory methods , POE broad understanding, PDE (pre-design evaluation) Survey/ questionnaire Walk-through, excursion, A walk around the block, physical traces- Behaviour vs. Design	Comparing data, Studies of architecture, comfort, questionnaire Generic methods for various use: current use of space, explore experiences of users, satisfaction, efficiency, existing work practice, context Occupant survey, Diagnostic tool Workshops, narratives (story telling), pictures, personas, future scenarios, simulations Questionnaire, space measurement, walk-through, survey, focus groups, forum structured route and focus areas, positive and negative aspects, walk with everyday users and visitors
Beauty/ Form	
<i>Venustas</i>	
Mental map , Place understanding, Townscape, Serial vision Place identity and role Semantic differential scheme SAVE (1990) Survey for Architectural Values in the Environment 1,2,3 method	Drawing important places on a map, comparison, Aesthetical expression, intentions, symbolic value Systematic sketches and notes people's perceptions, culture, cognitive ecology Scheme parameters: complexity, originality, pleasantness, experience etc. Mapping architectural values, atlas. topographic, historic, architectonic analysis 1- Immediate impressions - sketches and notes. 2- analysis, 3- consolidated place assessment

Method	Summary of tools and focus
Usability	
<i>Utilitas</i>	
AEDET, ASPECT, QIND, CIC DQI BUS Occupant survey, OBU Healthcare POE Method CIC Design Quality Indicators De Montfort method Healthcare Design Action Kit Healthcare Design Quality Assessment Method Interaction model for the emotional process Mapping, analysis of space and relations Overall Liking Score PROBE Quality of city space and 3 types of activities ST&M, ASTM standards USE tool User patterns, time/activity/space studies example: SUM space utilization monitor (CfPB) WODI, WODI Light (CfPB)	Study by designers, functionality Building walk-throughs, occupant satisfaction Questionnaire, focus groups Questionnaire, Functionality, building quality/impact Forum, walk-through Checklist for managers and architects, assessing built environment with patients eyes, patient inquiry, family Questionnaire, open questions, design effect on users Physical environment and patients behaviour, mood Space utilisation, mapping User survey on comfort and well-being Questionnaire/ Focus groups/ Visual surveys, energy assessment, Performance of systems Systematic assessment, spaces of good quality have many of optional and supplementary activities functional requirements test Usability walk-through, user survey, process guideline Space utilisation, self-reported and registered study of time/activity/space Questionnaire, KPIs database, employee satisfaction, productivity
Technology / Durability	
<i>Firmitas</i>	
BRE Design Quality Method (DQM) Commissioning Energy Assessment and Reporting Methodology LEED, BREAM, DGNB, DK-GB POE traditionally, BPE (Building Performance Evaluation)	Questionnaire, architecture, indoor climate, Life Cycle Cost (LCC), user satisfaction Validation of performance, interplay, installations Energy use survey, data collection from energy bills Excellence, energy labels, green certificates Questionnaire, Energy assessment, monitoring, space measurement, cost analysis, data collection, interviews

3.4.5. Applying evaluation methods in hospital projects at different building phases

As I wrote in Paper 4, the building performance and usability assessments are complex, and therefore they require multi-method strategies using a triangulation of methods and evaluations with multiple perspectives (Lindahl et al., 2012). The three hospital case studies, described in chapter 4, have shown that hospital projects can use various evaluation methods for different reasons. I present a generic example model, where I

arrange different existing evaluation methods, with different aims, and propose to use those in specific phases of hospital projects; see Figure 14.

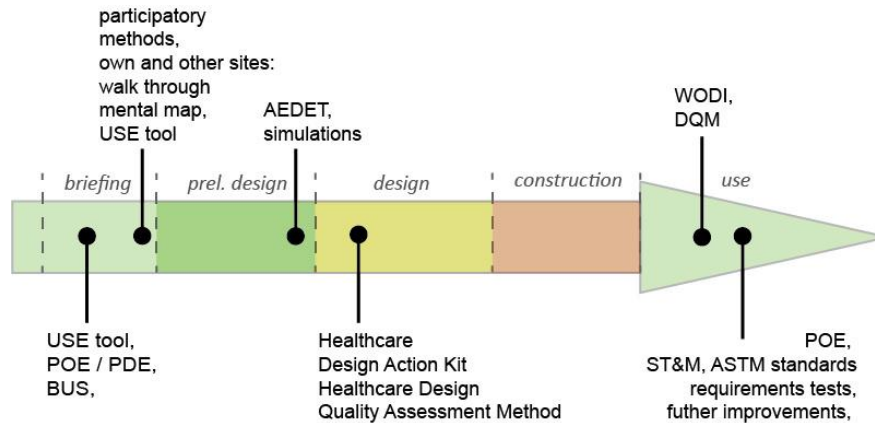


Figure 14 Example model of evaluation methods used at different phases of hospital projects

In the briefing phase for new healthcare facilities I propose conducting usability evaluations of buildings, like POE and PDE (Pre-Design Evaluation) and also evaluating alternative scenarios (Ornstein and Andrade, 2012) using for example the USE tool, mental map and participatory methods. I suggest that “users can and perhaps should be involved in much earlier stages of project development and in a much broader extent than traditionally in the building sector. One of the possible ways is to make Usability evaluations at early design stages, in cooperation of the design team and users of buildings, which are similar to the planned one. In that way co-learning can occur and there can be achieved a deeper understanding of users’ needs and potential possibilities. The claim is that this would result in a better usability of the built environment” (Paper 4). Some of the evaluation methods can be run on own existing facilities for future comparison, and for learning which areas need improvement and which are ideal and need to be kept. There should also be walk-through evaluations of best cases, both for inspiration in terms of beauty, usability and technology, but also to provide a common base for the project participants.

In the preliminary design phase, I propose evaluation methods that help the architects in the early process, methods such as *User patterns* and *Learning from experience*. The team can get valuable and structured information about space utilisation and uncover the previous experiences, in order to rethink and innovate from the current situation and together with the client choose the right scenarios for the future.

The following design phase is where main decisions have already been taken, but there are still lots of complex design solutions that need to be chosen. In order to optimise that process some evaluation methods can be used to learn from other locations and experiences, methods like *AEDET* and especially for hospital projects the *Healthcare Design Action Kit* to help the functionality issues. Another possibility is running simulations of the preliminary design solutions, which can possibly find improvements in how the architecture and layout can support the future organisation.

The construction phase has legally specified procedures for evaluations, as part of quality management and compliance with building codes, etc.

In the use phase I propose conducting evaluations for testing if requirements are met and possibly make improvements, but also to teach the users how to operate the building and check the satisfaction of different users and productivity levels in the organisation.

Examples are WODI, POE and ST&M, see Table 5 and Figure 13.

The models described in this chapter and Paper 4 can structure thinking about types of evaluations, the reasons for doing evaluation, expected process, focus and results and use of the right tools at the various stages of hospital projects. In that way the client can secure both meaningful process and results, but also user involvement, providing a common understanding, inspirations, co-creation and innovation for the future hospital facility.

3.5. DESIGN OF HOSPITALS

The descriptions in the following sections are about Design of hospitals and will be restricted to summaries of five main themes:

- Hospital users
- Empirical context – specific issues
- Evidence Based Design
- Building design phases
- Participatory design

The first section is describing user categories and the Scandinavian way of involving users. Then, the empirical context is studied, with hospitals seen as complex buildings, with specific requirements and issues of politics and hygiene. Third, the research on Evidence Based Design is shortly summarised. Fourth, the building design phases and their contents are presented. Last, the research on concepts of participatory design and co-creation with users is presented.

Many other design research and hospital practice subjects are omitted, because they do not directly affect or help building the usability briefing concept, which is the objective of this research project.

3.5.1. Who is the user? Categorisation of hospital users and stakeholders

The users and all stakeholders in the empirical context of hospital projects can be divided to several types.

First of all, the concept of stakeholder is defined by International Organization for Standardization (ISO/IEC, 2008) as: "individual or organization having a right, share, claim or interest in a system or in its possession of characteristics that meet their needs and expectations ". Another definition of a stakeholder (Freeman, 1984) is: "a group or individual who can affect or be affected by the achievement of a project."

Stakeholders can be of two types. First type has the power and can influence the development of a building (Ivory, 2004; Ward & Chapman, 2008). Second type is influenced by others (Welch & Wilkinson, 2005). It is necessary to have either the stakeholders' acceptance or their contribution to complete the project (Storvang & Clarke, 2014).

As I mentioned in Paper 3, recent research organised the users of the built environment according to various criteria. The division of the stakeholders can be in demand and supply side (Kernohan et al, 1992) or client-buyer (Alexander, 2003). The Norwegian studies, like (Haugen, 2008; Sæbøe and Blakstad, 2009) mention the user, the owner, the facilities manager. In (Olsson, Blakstad, & Hansen, 2010) the users are divided into six user categories as shown in Figure 15.

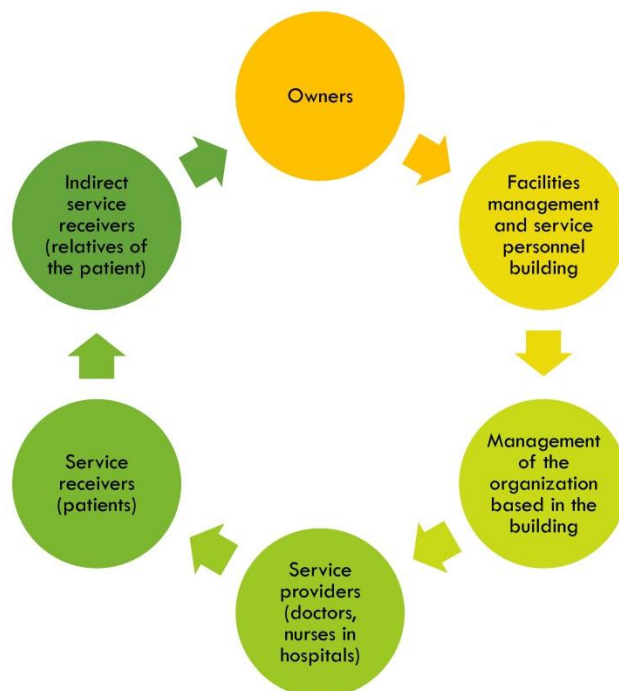


Figure 15 Six User categories “Who is the user?”, based on (Olsson et al., 2010)

I see an even broader picture of the users/stakeholders in design of hospitals, see Figure 16.

First, there are patients and their relatives. Furthermore there is the medical staff and client organization (managers, facilities managers and architects), support staff and various external consultants (architects, engineers, designers, work environment specialists etc.). Last, but not least, we can see the whole society as an important user, in a few ways. Everybody is a potential patient, relative or user of hospital facilities, e.g. public spaces, meeting rooms, cafes. Furthermore, there are also direct neighbours of the hospital, which could be considered users, as they share the area, and traffic system. The society in general is also a user and owner of public hospitals, they can be seen as taxpayers, voters and politicians, organised in governmental, state and regional authorities, and last – media, accessing and reporting information about the hospital to the society. I ordered them in the centric model, because the involvement changes the character.

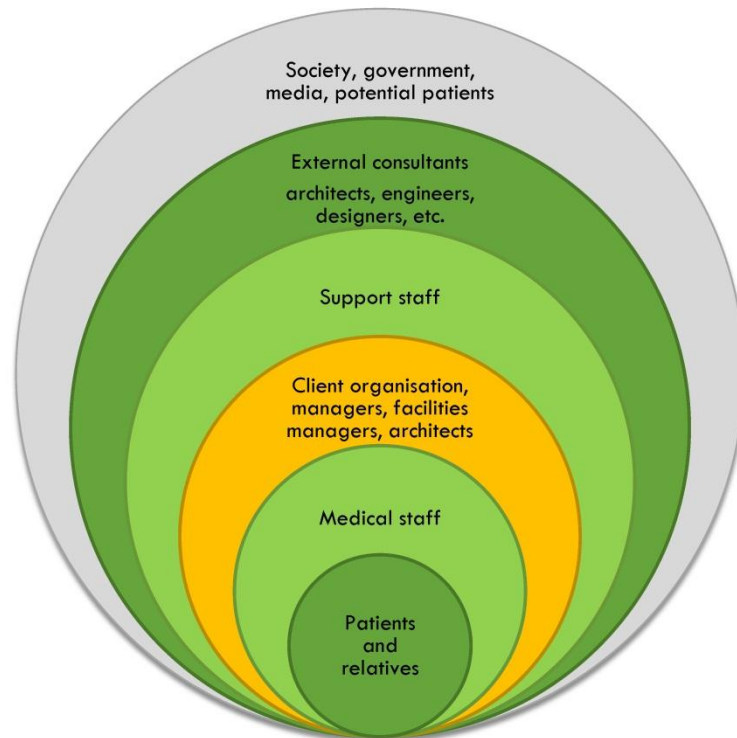


Figure 16 Stakeholders and users of hospitals

The more central, the more users are involved in the specifications of requirements and decision making and/or are affected by them. The more external the placement, the more the information is static, with exception of external consultants, who are co-creating the solutions with the more central users, as patients, doctors and client organisation.

3.5.1.1. Users involved in “Scandinavian” way

The Scandinavian and Danish context is also noticeable in the way the users are being involved in the hospital building projects. As shown in

Figure 9, there is a Scandinavian way of participatory user involvement.

It is something very natural in Scandinavian countries, with the trade unions history, that people, no matter their position in the organisation, are both eager to tell their opinion, and affect their organisation and are expected to do so for the best of all. The democratic rights and right to be heard are widely understood as something obvious and reaching far, not only in politics or public sector but also in private companies. You could say the employees or users are empowered to act. On the other hand hospital staff is often facing job reductions and reorganisations and therefore might not be as powerful as in the past.

3.5.2. Empirical context of hospital design and special issues: complexity, politics, hygiene

Hospitals and their cultural, social and medical history, starting from antique, are described for example by (Risse, 1990). Modern examples of hospitals and some general issues and

new approaches to designing hospitals are presented by (Heslet & Dirckinck-Holmfeld, 2007).

The hospital buildings and layouts transformed radically following the historical traits and can be divided in three major groups:

1. The aesthetical hospital (in Denmark 1757-1910),
2. The pavilion hospital, the hygiene hospital (in Denmark 1910-1970),
3. The technological hospital (in Denmark 1970 - present)

Worth mentioning is the concept of a pavilion layout from XVIII century, that was meant to stop the risk of infection by more air and light access in the hospital buildings. The first built pavilion hospital is the Hopital Lariboisiere in Paris from 1840, with two comb-shaped buildings and a central courtyard (Heslet & Dirckinck-Holmfeld, 2007). One of my case studies, the Bispebjerg Hospital is of exactly the type of pavilion hospital, also referred to as the hygiene hospital.

3.5.2.1. Hospitals as complex buildings

Hospitals are sometimes referred to as complex buildings. *Merriam-Webster* dictionary defines “complex” as: “1. a whole made up of complicated or interrelated parts” and “2.c. a group of obviously related units of which the degree and nature of the relationship is imperfectly known” (Merriam-Webster, 2016).

Jensø and Haugen (Jensø & Haugen, 2005) see hospital buildings as “characterised by major complexity (...) and affected by rapid changes and trends”. Chief Architect at Case 3 SOH refers to hospitals as complex, and lists following items: many types of users, facilities management and many factors (Aslaksen interview, 7-06-2011).

Hospitals are indeed complex, because the multitude of interrelated functions, medical departments depending on each other’s results, as well as technologically advanced medical devices. Both the building units and the organisational units of the hospital are imperfectly known. Especially the future demands are impossible to fully predict, because of demographical, societal and medicinal changes, as well as technological development.

3.5.2.2. Politics and hygiene

There are two specific aspects of designing hospitals that shall be remembered at all times. First, the planning and running hospitals is a political process. The public hospitals are funded by the society by taxes and affected by decisions made by politicians, which are changing depending on the voting results. The political decision can have a huge impact on the whole healthcare system in each country, including centralising or decentralising access to healthcare, building new hospitals or merging or closing some of them.

The second special aspect is hygiene. It is the most often used argument against new materials and uncommon solutions. For example new floor materials or use of textiles in the patient rooms must be carefully tested to pass the strict hygienic standards and

prevent antibiotic resistance. As noticed by researchers “textiles seem to be slowly vanishing from the Danish hospital environment due to (...) a strong rationale around hygiene” (Jørgensen et al., 2011 in Heimdal, 2014).

3.5.2.3. Differences in designing for hospitals and other buildings

There are a number of major differences in the briefing and design process for hospital projects and other types of buildings. The first difference is in the client organisation of the building projects. In the hospital projects the building client is a public authority, with its specific requirements for the process. The second difference is the amount of different types of stakeholders and users, and their involvement in the decision making and design. As I wrote in the introduction, see section 1.1, there was a total absence of the users in the design of shopping centre projects. On the other hand there is a broad picture of users and stakeholders in the hospital projects, described earlier in this chapter, and there is a need to involve many of them in order to understand the complex structure of the hospital. The third major difference is the focus and goals of the finished facility, which needs to be supported by the building. While hospitals focus on diagnosing, operating and healing the patient in an appropriate environment with the necessary technical infrastructure, others, for example the shopping centres focus on making money, entertainment and pleasure of the visitors, and airports - on delivering the travellers and goods securely and on time to different destinations. Furthermore, hospitals are usually public buildings and must serve all, not just privileged group. In other words, the hospital needs a different design approach and understanding of its focus, processes and users.

3.5.2.4. Hospital projects in Denmark

In Denmark there are currently planned and built 43 hospital projects that will be completed over the next 10 years, see Table 6. They can be divided to 32 somatic and 11 psychiatric hospital projects. 13 of the projects are in the Capital Region of Denmark. All the projects are funded by Danish regions or co-financed by Kvalitetsfonden.

The projects are of two types. Either entirely new hospitals with new hospital buildings often at new sites or further development of the existing hospitals, often accompanied by a merging process with other hospitals. The initial phases of design processes with user involvement and competition programming are of interest in the media and building industry, for example by The Danish Association of Construction Clients, which has made a series of workshops with those subjects, which I followed. The aim is to obtain excellent modern hospitals that support the needs of future patients, health professionals and the society.

At the same time there is a noticeable industry boom and growing interest by architectural and engineering firms in hospital design, especially after the economic crisis and years of stagnation in the building sector. The contrast between the many big hospital projects in Denmark and recession in other types of buildings is obviously visible to anyone interested in the built environment.

LITERATURE STUDY

Table 6 Current hospital projects in Denmark, divided in somatic and psychiatric (Danske Regioner 2012), Case Studies marked yellow

Hospital, project parts	Project period	somatic	psychiatric
Det Nye Rigshospital, Regional Sterilcentral Rigshospitalet/Det Nye Rigshospital	2009 - 2017	+	+
Gentofte Hospital	ND	+	
Bispebjerg Hospital: Nyt Hospital Bispebjerg, Ny Psykiatri Bispebjerg	2010 - 2025	+	+
Ny Retspsykiatri Sct. Hans, Roskilde	2009 - 2020		+
Nyt Hospital Glostrup	2011 - 2018	+	
Nyt Hospital Herlev, Onkologisk Ambulatorium, Herlev Hospital, Regional Sterilcentral Herlev/Nyt Hospital Herlev	2009 – 2017 2013 - 2018	+	+
Nyt Hospital Hvidovre	2009 - 2020	+	
Nyt Hospital Nordsjælland, Hillerød	2010 - 2020	+	
Ny Psykiatri Ballerup	2009 - 2017		+
Det Nye hospital i Vest, DNV-Gødstrup, Det Nye Hospital i Vest, DNV-Gødstrup (psykiatri)	2007-2019 2014-2019	+	+
Det nye Universitetshospital i Aarhus - DNU Det nye Universitetshospital i Aarhus - DNU (Psykiatri) Dansk Center for Partikelterapi, Aarhus - DNU	2005-2019 2008-2019 2014-2017	+	+
Regionshospitalet Horsens	2007-2021	+	
Regionshospitalet Randers	2007-2017	+	
Regionshospitalet Viborg	2007-2019	+	
Fælles Akutmodtagelse, Hjørring, Ny behandlingsbygning, Sygehus Vendsyssel i Hjørring Nyt kvinde-/barnhus, Sygehus Vendsyssel i Hjørring, Renovering af 9 etagers sengebygning, Sygehus Vendsyssel i Hjørring	2007-2013	+	+
Fælles Akutmodtagelse, Thisted	-2013	+	
Nyt Aalborg Universitetshospital Onkologi, Aalborg Sygehus Syd	2010 – 2020 -2013	+	
Universitetssygehus Køge	2011 - 2021	+	
Nykøbing Falster Sygehus	2012 - 2017	+	
Nyt psykiatrisygehus Slagelse Slagelse Sygehus, fase I Akutmodtagelse Slagelse Sygehus, fase II, OPP	-2015 -2013 2012 - 2017	+	+
Esbjerg Psykiatri Esbjerg Sygehus	2010-2015 2010-2020	+	+
Kolding Sygehus	2009-2017	+	
Middelfart Psykiatri	-2013		+
Nyt Universitetshospital i Odense - Nyt OUH, psykiatri Nyt Universitetshospital i Odense - Nyt OUH, somatik	2008-2022 2008-2022	+	+
OPP Vejle - psykiatri	2012-2017		+
Specialsygehus Sønderborg	2012-2021	+	
Sygehus Sønderjylland, Aabenraa Aabenraa Psykiatri	2010-2020 -2015	+	+
Total: 43 (on 27 locations)		32	11

3.5.3. Evidence Based Design - healing architecture

The development of *Evidence-Based Design (EBD)* concept started with a publication by Roger Ulrich in Science (R. S Ulrich, 1984) with a self-explanatory title: “A view through a window may influence recovery from surgery”. The same author provided the definition of EBD as the following: “the design process, which is guided by an empirical understanding of the effects of health-care physical environments on safety, efficiency, and clinical outcomes” (R. Ulrich, 2006). Ulrich presents the strong scientific foundation with over 700 rigorous studies in the USA, which gives evidence to the fact that “good design of a hospital’s physical environment promotes better clinical outcomes, increases safety, and reduces stress for both patients and staff” (R. Ulrich, 2006). He presented and explained examples of a number of parameters from research, giving evidence that architecture affects health.

A few examples of the EBD parameters and typical remedies are summarised below:

- Noise, stress – remedy: single-beds, sound absorbing ceilings,
- Safety and reducing infections (airborne and contact) – remedy: single rooms, filtration, air changes, separation of patients, wash basins and gel dispensers close to staff work paths in visually prominent locations
- Staff fatigue – remedy: floor layouts with decentralised nurse charting, observation stations and supplies dispersed close to patient rooms, viewing windows – visual access to patients
- Depression and pain – remedy: higher daylight exposure in patients’ rooms, via effects on serotonin, building orientation, view of nature and or people with positive facial expressions

Ulrich (Roger S Ulrich, 2006) summarises the advantages of single-bed rooms: quieter environment, lower risk of infection, greater privacy, confidentiality, improved staff communication, improved social support from family and friends, higher patient satisfaction with overall quality of hospital care. He stresses, that the research outcomes deny the common belief of some medical professionals that in multi-bed rooms patients give each other stress-reducing social support.

Ulrich also examines the additional costs of inclusion of the EBD proposed solutions and upgrades, which would add 5.3 % to the initial construction cost. He adds however that “the one-time incremental costs would be recaptured in only one year and the revenue gains would recur annually” (R. Ulrich, 2006). In this light EBD can be seen as a long term investment in the well-being and safety of the patients and staff.

Multiple other publications cover the concept of *Evidence Based Design*: (Cesario, 2009; Hamilton, 2009; McCarthy, 2004; Pati, 2011; Roger S. Ulrich, 2001; Roger S. Ulrich et al., 2008; Roger S Ulrich, 1992; Roger S Ulrich et al., 2010).

The concept of *Healing Architecture* emerged from Evidence Based Design and is often another term for the same practices.

The non-profit organisation Planetree from USA was an important part of the development of EBD and the *Planetree* model, which is about patient focused healthcare, promotes the mental, emotional, spiritual, social and physical healing process (Larssen, 2011) p.113. The Planetree model was for example used as a base for planning St. Olavs Hospital in Trondheim (Case 3); see (Jensø & Haugen, 2005). The Chief Architect at SOH case referred to healing architecture, not as being fashion (interview 7-06-2011 00:04). She showed the Planetree graph (interview 7-06-2011, 0:27) with the patient in the centre, and two axes of: people - building, and quantity – quality. Nevertheless, she adds that it is a "great challenge to change a space from being a workplace to space for healing" (interview 7-06-2011, 0:31:23).

Furthermore, the concepts of healing architecture and EBD has initiated a Danish research in hospitals and resulted in a related concept of *Hospital Of The Senses* (in Danish: *Sansernes Hospital*), adding the *stimulation of senses* to the repertoire of design decisions based on evidence. It was described in a bestseller book "*Sansernes Hospital*" (Heslet & Dirckinck-Holmfeld, 2007). The authors conceptualise the new paradigm and a new archetype of hospital, which after the 1.aesthetic, 2.hygienic and 3.technological hospital, would be the 4.hospital of the senses. This fourth type is a humanistic, stress-free hospital, which further improves the effect of the medical sciences.

The concept seemed very relevant to the topic of my PhD study, but in the fieldwork, both the comments in the case studies and in a number of additional expert interviews, which I conducted, the Danish architects relate to the new suggestions of EBD concept as something the Scandinavian architects always knew and intuitively practiced and which is now just repacked under a new fancy name. They mentioned the Danish and Scandinavian architectural long traditions of designing with access to daylight and views to nature. Unfortunately, they wished to stay anonymous with those citations, as their companies nowadays sell their design to the clients, also under this fancy name. Therefore I decided not to study all the hospital cases with this particular research focus, apart of case 3 SOH.

The understanding of the concepts of EBD and Healing architecture is though not limited to the use of existing medical evaluations from USA and UK. I suggest in this PhD thesis that any hospital building client or hospital architect can learn from own or others' evaluations and base their design decisions on evidence, which is part of my proposition of Usability Briefing model and is explained in chapter 5.

3.5.4. Building phases

In this section I present the guidelines for phases of building project from UK, USA and Denmark (RIBA, 2013; AIA, 2007; DANSKE ARK/ FRI, 2012). Each of them name briefing as the first or second phase of the project, see Table 7. The Royal Institute of British Architects (RIBA, 2013) proposes a phase 0 with Strategic Definition, followed by phase 1 Preparation and Brief. The American Institute of Architects (AIA) presented an Integrated Project Delivery in 2007, where the first phase is called *Conceptualization* or *Expanded Programming*, and they suggest that design decisions are moved earliest in the process, where they are more effective and less costly. The Danish Association of Architectural

Firms (DANSKE ARK) and the Danish Association of Consulting Engineers (FRI) together published a “Performance description Building and Planning” in 2012, where after appraisal 1.1, there is a phase 1.2 with English name: Design specification, but Danish name is: *Byggeprogrammering*, which means building programming/briefing. The overview of the phases of design phases in different countries is shown in Table 7.

Table 7 Overview of design phases in different countries by professional architectural associations (RIBA, 2013; AIA, 2007; DANSKE ARK/ FRI, 2012)

	Pre – project		Project				Post - project		
RIBA 2013	0 Strategic definition	1 Preparation & Brief	2 Concept Design	3 Developed Design	4 Technical Design	5 Construction	6 Hand-over	7 In Use	
AIA 2007	Conceptualisation (Expanded Programming)		Criteria Design	Detailed Design	Implementation Documents Final Buyout	Construction			
Danske Ark/ FRI, 2012	1.1 Appraisal	1.2 Design specification	3.1 Outline proposal	3.2 , 3.3 Project proposal	3.4 Main project	4 Construction phase		5 Operational phase	8.17 Process Management/ consultancy user involvement, final evaluations

3.5.5. Participatory design and co-creation with users

“Participatory Design is the direct involvement of people in the shaping of future artefacts” (Eva Brandt, 2006).

The participatory design, as well as experiences and methods for co-creation with users were described by many researchers (Binder, Brandt, & Gregory, 2008; Binder & Brandt, 2008; E Brandt, Binder, & Malmberg, 2010; Bratteteig & Wagner, 2012). Some researchers (Buur & Matthews, 2008) combine the three concepts of: 1) Lead-user approach, 2) participatory design and 3) design anthropology into a proposal of *Participatory Innovation*.

Oijevar et al. (Oijevar, Jovanovic, & Otter, 2009) presented a tool for “architects getting users involved in the right and adequate way”. By using it, the architects get an overview on the type of user involvement needed, the frequency of the involvement and the type of user involvement for the next phase in the planning and design. This tool with an overview of phases gave inspiration to my usability briefing model.

LITERATURE STUDY

A few concepts of participatory design were studied further and used directly in the case studies. Brandt described the *Exploratory Design games* for use in participatory design (Eva Brandt, 2006). They are defined as both the artefacts and a set of rules for their use. Some of the design games examples are directly used as boundary objects in my case study 1- HIL, for example the *Landscape Game*, that was modified and applied. It is further referred to as the *Ovals design game*.

Another relevant concept is a *Design:Lab* - “open collaborations between many stakeholders sharing a mutual interest in design research in a particular field” (Binder & Brandt, 2008). Design games are part of the collaborative design experiments in Design Labs and some are introduced as examples, for example *Layout Design Game*, that was implemented in Factory Design:Lab. The *Layout Design Game* is also used as a boundary object in my case study 1- HIL, and is referred further as *Squares*.



Figure 17 *Toolbox for participatory design of workplaces, (Conceição et al., 2014)*

A PhD thesis (Våland, 2010) exemplifies user participation and the methods used in project cases with architectural companies. A set of tools for participatory design in architectural practice was presented by (Conceição, Broberg, & Lundsgaard, 2014) and included a toolbox of new work-practices, methods and techniques that involve users when designing new workspaces. The toolbox contains four elements: 1) four booklets, 2) “playing” cards, 3) a game board, and 4) a leaflet explaining the main process the tool aims at bringing participants through it; see the toolbox in use at Figure 17.

Broberg et al. characterized different boundary objects in relation to how well they function (Broberg et al., 2011).

4. EMPIRICAL STUDIES

This chapter presents the three main case studies and additional data collection from explorative and validation expert interviews and focus group workshop. Section 4.1 presents Case 1, which is Healthcare Innovation Lab, organised by the Capital Region in Denmark. Section 4.2 presents Case 2 – Bispebjerg Hospital, Copenhagen, Denmark. Section 4.3 covers Case 3 – St. Olavs Hospital in Trondheim, Norway.

As previously described in section 2.3.3 this thesis uses a triangulation of both data in multiple case studies and a triangulation of research methods in order to reach more generalizable results and strengthen the final conclusions. The criteria for choosing hospital case studies are described in section 2.3.4 Case study research. The three particular hospital cases were chosen because of novelty and variety of procedures.

All cases are compared in section 4.4 with cross case analysis; see an overview in Table 8. The process of collecting additional data from expert interviews and focus group validation workshop are described in section 4.5.

In general, there were 140 documented events - conducted explorative expert interviews, validation expert interviews, meetings and workshops, discussions and presentations, and one focus group validation workshop. In Case 1 HIL 24 events (interviews, workshops) are documented, in Case 2 BH - 27 events and Case 3 SOH is built on 2 interviews, e-mails and literature review.

For validity, a list of the data sources, all main events from empirical studies – workshops, meetings and interviews, from all case studies and external expert interviews are listed in APPENDIX.

4.1. CASE 1 - HEALTHCARE INNOVATION LAB (HIL), Denmark

This section presents the case study, which I also described in Paper 3. First section includes general information about the case study. In the next sections the data collection is explained and the three phases of the HIL project are described. For each phase the boundary objects - characteristic methods and tools used in the workshops are described with accompanying reflections on the process. Each phase findings are the evaluations of the methods and objects, as well as their impact on the design results. The last section presents general findings and conclusions about the whole process and involved users.

4.1.1. Case description

The case study was conducted at the Gynaecological Department at Herlev Hospital as part of Healthcare Innovation Lab (HIL), which is a public-private collaboration project testing methods for simulation and user-driven innovation between users and companies at

Hospitals in the Danish Capital Region. HIL is a development project which aims to demonstrate the feasibility of establishing a permanent healthcare innovation laboratory. A specific goal was specified as developing of new methods for simulation. It involves users, hospitals, scientific and research institutions, patients and relatives, as well as companies. The users at HIL are widely understood as the medical staff, with only a short participation of patients in the project. The HIL project is funded by the program of the Danish Enterprise and Construction Authority (Danish: Erhvervs- og Byggestyrelsen) on user driven innovation.

In the beginning of 2010 the objectives and success criteria of the HIL project and its part projects were specified. The studied case is the HIL project A – The Outpatient Clinic of The Future, focusing on functional and organisational planning of hospital facilities. It consisted of observations, workshops and simulations with users at the Herlev Hospital in the period September 2010 - June 2011. The chronological overview of the process and methods is presented in Figure 18, which I divided to three phases of *Exploring*, *Development* and *Validation*, and ten steps, different activities at workshops.



Figure 18 Chronological overview of the process and methods at HIL project A

4.1.2. Data collection

I, as a researcher, participated in the HIL A project as one of the facilitators, whose role was mostly to observe and facilitate the process, but at a few events we were also participants and co-creators of the result. It means that user driven innovation is then of two types: design “by users” and sometimes “with users”. Compared with the traditional design “for users” the case provided an excellent best practice of the extensive user involvement and user-driven innovation. Furthermore, I was video-recording or sound recording the workshops and took notes.

A detailed list of the workshops, meetings and interviews in this and other case studies is available in APPENDIX.

The theories described in chapter 3 LITERATURE STUDY can be combined to describe and analyse the case study. In the case study, the involvement of users was executed as a *user driven innovation* process and *design games* were applied. Furthermore, the *boundary objects* were used as tools at workshops and the goal, among others, was to generate ideas for a new workplace, *design a hospital of high usability*.

4.1.3. Description and findings from workshops, design games, simulations

Phase 1 Exploring

At the first workshop (step 1) facilitators and users discussed the developing of a future concept. It was important for the group to start with an agreement on the aims and expectations, so the planned activities would run smoothly.

The methods and boundary objects used were post-its with written individual wishes and comments, which were placed on a round bull-eye target poster in order to communicate and prioritise the needs of both groups (Figure 19, picture no. 1). The result of the prioritising game about expectations was a set of rules and agreements for further observation at the department, staff and patient involvement in the project. It provided a common understanding of the special legal and ethical conditions of user involvement at healthcare facilities with respect for clinicians, patients and relatives. It also secured goodwill of cooperation with the user group. The boundary objects seemed to be easily understandable and fitted to the task.



Figure 19 Phase 1 - Exploring, no.1 - Workshop about expectations, no.3 - Observations at the outpatient department. Adapted from Paper 3.

The next workshop (step 2) was an exciting experience for all participants, where the user group and the facilitators were innovating together. The goal was defined as: creating visions for the future, defining patient flow in steps through department and prototyping of treatment room. The workshop was loosely structured and the roles of participants were not defined clearly from the start. The boundary objects used were blank posters, colourful post-its, markers, Duplo figures and blocks. The workshop was very productive, but created opposite and unpredictable results from the two sub-groups. One user group was bound to present reality, while defining the patient steps through physical design, but

was innovative in prototyping and describing future patient types/needs. They invented a “Royal Model”, where medical staff comes to a patient room with mobile equipment instead of patients going around the department for specific treatments. The other user group, on the other hand, had untraditional visions, but reduced them to traditional solutions when prototyping. The positive conclusion was that in general it is possible to change and innovate with staff and that workshops can be very productive. The critical conclusions of the facilitators were the awareness of a need for clearer rules to user exercises in future workshops and the need of clear roles for both users and facilitators. Another critical conclusion was the need for a more specific definition of expected aims and structure of each exercise to achieve a uniform result, as the user groups seemed a bit too free and unfocused at times. Nevertheless, the step 2 workshop resulted in some useful results: It defined a typical patient flow in steps, provided information about expectations of future patient types and needs and invented the Royal model concept.



Figure 20 Case 1- HIL, Aneta Fronczek-Munter video filming the discussions at a workshop, photo: Ole Broberg

The following step 3 was a number of observations at the department (Figure 19, picture no.3), where the facilitators were *shadowing* staff, for example a nurse, and observed specific topics: staff-, patient- and journal-flow and how well the physical environment supports the activities. The individual lists of issues on the three topics were gathered into a common list of challenges in the department. The facilitators achieved a better understanding of the daily routines and issues that need to be addressed in the future plans. The list of challenges was presented to the medical staff in a short and condensed form, and was recognised by them as an understanding of their recent position and the need of changes.

The Boundary Objects used in the *phase 1 Exploring* were of three categories. The first two workshops used *objects*: posters and post-its. The third activity, the department visit, was of BO category *processes*, but also used the *standardised forms* in the lists of issues. All of the BOs were easily understood by the users and had strong characteristics of BO - they were actively created by participants, gave possibilities for action, and enabled participants

into “design mode”. The facilitators learned the fourth important characteristic of BO during the workshops – the need of rules and instructions.

Phase 2 Development

Phase 2 was a new series of workshops with users (steps 4-7) which took place at Herlev Hospital. The facilitators prepared the process thoroughly at meetings beforehand and chose potential best tasks, tools and objects that can ease the collective process of communication and design. The expectations to outcome were addressed as well. The facilitators took single roles to play – some were structuring the meeting, some asking questions to specific topics, some were observing and taking notes and some video filming. The users exclusively discussed the future needs and designed the future possible solutions with each other. The facilitators could inspire or provoke for new solutions to be invented, but it was the users taking decisions and working on the design. The boundary objects were paper posters, post-its and markers and the facilitators were guiding the users through the task by asking relevant questions and helping drawing the maps according to the given answers.

The results of step 4 were communication maps showing the variety of tasks involving others, different to each specialisation. Step 5 resulted in an overview of different processes of the specialisations. Finally the break downs were identified and marked visually on both of the maps. The conclusion after steps 4 and 5 was that structuring the process and roles was helping to gain a comparable result for each user group. The process maps (step 5) also showed how the view on the patient flow and staff process varies and depends significantly on which particular professional group of the medical staff the participants belonged to.

The workshops with design games (steps 6 and 7) were very productive and remembered by all participants. Step 6 was a design game called Ovals or Flower. The boundary objects were a poster with abstract oval forms, small papers with icons/photos/names of rooms, and a possibility to make new ones and placing them according to users’ own rules and common agreements. The task was to translate the drawing freely and organise the functions accordingly (Figure 21, picture no.6). The participants were very excited and discussed the understanding of the task and possible solutions. The ideas were innovative and discussions covered both physical and organisational topics. The result was a design of 3 levels with common areas in a central position, and all patients arriving at the same place. Another new idea was a command bridge with a coordinator.

The next design game was Squares (step 7), see Figure 21, picture no. 7. It was meant to continue and further detail the solutions from the previous exercise. The boundary objects were also posters, but this time with a square grid printed on it, yellow and blue squares, icons and names for room functions and Duplo person figures to play staff or patient flow through. The task for the user group was to distribute functions and rooms and organise them with yellow squares for rooms with access to staff only, and blue squares for areas with patient access. The participants felt more restricted by more realistic square rooms,

and only one level solution, but tried to keep and translate previous ideas to new rules – kept the central place and many related functions close to each other.



Figure 21 Phase 2 – Development, no.6 – Ovals design game, no.7 - Squares design game. Adapted from Paper 3.

The design results of the exercises at steps 6 and 7 were a functional plan of rooms, first divided in 3 levels, then forced to 1 level, defined physical proximity of functions, corresponding to wishes of the group and imagined expectations of the future patient. Another, unexpected result was a list of needed organisational changes for the future and the awareness of many assumptions and preconditions to organisation, technology, etc. Those were listed by the facilitators on a separate poster while the users discussed the issues.

Phase 2 *Development* used BOs of several types. The *Standardised methods* were drawings and handmade sketches. The *Objects and maps* examples were communication map, printed posters, Duplo person figures. There were also following *Repositories*: parts libraries in form of icons, names and pictures for rooms. Another type of BO was *Discourses* in the form of typical action situations in steps 4, 5, 6 and 7 or questioning situation in design games (steps 6 and 7), where the standard design and organisation solutions were questioned and new ones provoked. All BOs used in *phase 2* worked well as interaction instruments with the given rules and enabled a collaborative design process. They were prepared by facilitators and were created by users during workshops. The combination of boundary objects in form of well-prepared design games with Objects and Discourses was the most entertaining, productive and innovative.

Nevertheless, the designing process with ovals (step 6) seemed more playful for the users and more frustrating when using squares (step 7). The interesting question is what was special about the design game 6 and 7 that made the group respond so differently to them and the innovative results seemed easier/harder to obtain? The boundary objects and the task seemed quite similar, but it was much easier for the users to freely distribute the functions, have an overview of the whole department and innovate in the abstract oval forms, than in the more realistic squares. The conclusion is that the abstract BOs were more playful, free and easy to use and enabled the users into “design mode” easily. The BOs in squares on the other hand, were more serious and started many new discussions

about details, for example access to daylight and the solutions changed several times depending on the current focus.

The general conclusions from *phase 2* are the following. First, the tasks for users shall be structured and planned in advance and boundary objects chosen carefully to give the expected type of results, which can be for example more innovation and new ideas or specifications of details and prioritising of focus areas. Furthermore, the facilitators must be open to hear also other relevant results than planned, and support them too – here the facilitators got aware of a new topic with preconditions and started listing it simultaneously on another poster.

Phase 3 Validation

At the step 8 workshop - square concept validation - the results from previous design game were developed further and validated through playing specific patients' flow through them. The boundary objects were the previous posters with room arrangements, but included also typical patient stories to be played through a Duplo person that was being moved around the plan. The finding from that workshop is that the patient stories and the playing of the real patient through the future hospital helped the participants to change and optimise the plan further to fit as many patient's and staff's future wishes and needs as possible. On the other hand the changes were minor and an innovative spirit was missing.

Step 9, 3D design aimed at further validation and development of the users' concept for the future facility. The boundary objects used were 3D visualisations of specific areas in the future department (Figure 22, picture no.9). The pictures and plans were prepared beforehand by the facilitators and students according to the notes from the previous user workshops. It seemed to be a great start of new discussions about new topics like the atmosphere and look of the areas, the organisational issues together with interior details and furniture, as well as technical solutions to medical treatments and glass doors. The reality of the pictures allowed the user group to make their previous thoughts more precise. The users presented their results to the department management. The facilitators prepared the slides with updated notes on specific topics and the updated visualisations of the specific rooms. The group seemed very content to see their results looking so professional and real and were very engaged in telling the story. The structured and visual presentation slides may also have eased the process of presentation and explanation of the complex problems and solution ideas. Unfortunately the photorealistic 3D visualisations of the solutions had a weakness of focusing on the room sizes, furniture design and colours, and not so well showing the innovative solutions of the users, which were the organisational changes, proximity and arrangement of functions. If both should be represented in a professional way, then the user group should have had the designing architects involved in the workshops too.

The last workshop type was a number of simulations in step 10. The boundary objects in the simulations were paper sheets, empty boxes representing rooms, colourful post its, markers, Duplo figures representing patients and medical staff, egg timers, typical patient

flows and typical disruptions. The tasks were to arrange the room boxes on the table and play typical patient flows through department in steps with specified time use (Figure 22, picture no.10).



Figure 22 Phase 3 – Validation, no.9 - 3D design, illustration: Michael Mansdal Larsen and Ole Broberg, no.10 – Simulations, Adapted from Paper 3.

The users and facilitators were playing one figure at a time, moved it between the rooms, drew the walking lines with markers and set the allowed time for each step with the timers. Time in the simulations was accelerated three times, so the simulations were fast. The first simulations were representing a single patient, doctor, secretary and nurse, but later the number of participants was 10-15 and more realistic. The aim was to test the basic models of functional and organisational plans and evaluate the effectiveness, quality and overview. The exercise was very dynamic and quickly the previous solutions were abandoned and new ones developed by the group. The Royal model from phase 1 was tested too and found ineffective, because of waste in staff time use. Several other concepts and new “what if” ideas were tested. The common reflections of users and facilitators led to development of a new model – the “Star Model”. It has a coordination function, like in phase 2, now placed in the central room for medical staff. From here the doctors and nurses have access to the patient’s examination rooms arranged around it, in which the patients stay for both the conversations and examinations. The central coordination room is innovative for outpatient clinic both functionally and organisationally. It was easy to make an immediate simulation of the new concept and later test it with users from other hospitals that proved its potential qualities.

The boundary objects in phase 3 were various. Exercise 8 reused “old” BOs from squares - 7 - and was lacking innovation. The 3D models - 9 - were not made by the users directly; their ideas were translated and modelled by others. The table simulations – 10 - were flexible, quick, easy to use and surprised some of us by not only allowing the quick tests of models, but also the strong potential for new innovations. The validation of concepts, turned into innovation and development of new, improved concepts.

4.1.4. Analysis and reflections - process results and users

The workshops concentrated on how users move about in the physical environment. Thus they checked by a clock how much time the work tasks of the medical staff would take in the physical environment being designed. Furthermore, they drew lines, and marked by colour, persons moving from A to B, how long it takes, what the reason is and what the outcome might be.

The facilitators got aware that most of the workshops actually had not one, but several parallel themes of innovation. They could be divided into 3 themes:

- physical environment, rooms, needs, qualities and locations, functional plan
- organization, professional roles and activities
- preconditions for the future solutions

The finding was that some of the organisational roles would have to be redefined and there are a number of political and technological preconditions for the future solutions to be possible to achieve and turn the basic functional schemes to hospital of high usability.

Each workshop and the used boundary objects, previously described in the phase descriptions, are summarised and evaluated in Figure 23.

In the summarising report the simulation as an innovation tool is referred to as “a real eye-opener” and the results as combining the user involvement and simulation as “a test and analysis method” and together with a facilitation process give a ground-breaking and effective tool (Ruff & Jacobsen, 2012).

The active workshop participants in the HIL project A can be divided into two groups: users and facilitators. The users in this case were the medical staff including doctors, nurses and medical secretaries, while the facilitators were researchers, consultant companies and various specialists. There were also professionals, who followed only parts of the process as observers, i.e. management from the department and the architect representing new building processes at the hospital, responsible for the client briefing process, competition and coordination with external architects and designers.

There were a few patients and architects involved in the HIL case in minor extent. There were also users that participated only in some workshops, e.g. the Senior Hospital Physician at the event 1 and 2, which disturbed the continuity of the user involvement process, as the Royal Model did not get support and ownership from the new user group. The observing architect, representing the client was not co-creating the results, which could have been helpful in the designing and 3D modelling, which in this case was done by others, who were neither part of the group, nor the responsible architects. Moreover, the competition for new facility was already running at the time of the workshops, so the designing architects already received a functional brief, but also couldn't participate in workshops, as there were several competing companies.











Photo	Name, BO	Evaluation of Boundary Objects
	1 Expectations, Bull-eye target poster, post its, markers	Easy to use actively, communicate and prioritise, making common agreements
	2 Patient flow, Post its, markers, room prototyping	Innovative visions - Royal Model, traditional physical design, uneven results in groups, need for rules
	3 Observations, BO Process: Observing, hearing stories, listing of issues	Better understanding of the department, list of challenges,
	4 Map of Communication, Blank poster, drawing arrows showing communication	Easy to make, gives overview of tasks and communication between people, breakdowns
	5 Patient flow, Colourful post its, markers, notes, arranging steps - fishbone chart	Productive, easy to arrange patient steps and staff tasks - overview
	6 Design game Ovals, Poster with abstract ovals, icons and photos of rooms	Flexible, playful, free task, result: innovative ideas to organisation and building, users in “design mode”
	7 Design game Squares, Square grid, room icons, colourful squares	Restricted to reality, serious, frustrating, details development of functional plan, discussing the building
	8 Square concept validation, Square rooms, patient flow, Duplo figures	Small changes in arrangements, optimisation, no innovative spirit
	9 3D design, 3D visualisations of chosen areas	Discussing details, furniture, atmosphere, immediate changes by participants not possible, professional look
	10 Simulations, Room boxes, Duplo figures, patient flow, disturbances, egg timers	Testing basic models & innovating, easy, quick to test usability, organisation and functionality, new scenarios

Figure 23 Overview of the 10 steps at workshops in HIL project A, used boundary objects and their evaluation. Adapted from Paper 3.

Users actively involved in the case were limited when looking at the panorama of potential users, see section 3.5.1. The workshop participants were mostly medical staff, but also participants from the administrative staff. Patients were not involved at all in the workshops, but were represented alone in the focus of staff on patient needs and types and a few interviews. There are several other types of users of the built environment mentioned in literature and some groups were strikingly missing at the workshops, for example the architects and facility managers or support staff.

4.1.5. Summary and conclusions from case 1

After the series of workshops with user groups, some main conclusions can be made. The series of workshops had 3 phases and each resulted in a main innovative idea. The *exploring phase 1* resulted in a “Royal Model”, where the different doctors visit the patient’s room. *Phase 2* developed the Coordination Bridge and central room for patients.

The *Validation phase 3* not only tested the previous models, but further developed them into a new “*Star Model*”, with a central room for medical staff and coordination.

Depending on the methods used at the workshops the participants/users had different focus, changed the priorities and developed different solutions. Some of the BOs, the Ovals design game – step 6 - and Simulations – step 10 – were facilitating innovation the most. Both can be characterised by being flexible, open for translation and abstract. The conclusion is that those BOs were more playful, free and easy to use and enabled the users into “design mode” with focus on future needs and design of innovative solutions. On the other hand, other BOs, such as Squares – step 7 - and 3D design – step 9 - were more serious and seemed to lock the participants into the current situation and details or were more demanding.

The users actively involved in the case workshops were extremely limited when looking at the panorama of potential users and did not include patients, architects or facilities managers. The user categories at hospitals could be studied further with their potential roles in the planning of new facility and type of involvement.

The use of the workshop results at HIL could also be studied more thoroughly. The workshops in the case did not result in a usability briefing nor did the results feed into the briefing process; the architectural competition was running parallel already. Nevertheless the results might be used in future workshops with the architects that won the competition for the new hospital. The question to be answered is: how will and could results of such workshops be used?

My recommendations for future workshops about planning hospital facilities are the following: First, start the process early, so the results can be used for the actual competition brief. Second, make a stakeholder analysis, invite a broader range of users and keep the same people in the group. Furthermore, make a strategic plan for user involvement, where some shall be actively involved, some only informed and some make decisions. Moreover, plan the aims of each workshop exercise, structure the tasks and roles of individuals, and finally choose the tasks, games and boundary objects carefully to fit the expected focus and type of result.

After researching case 1 I made the following concluding remarks. Further study would be helpful to explore other methods of user involvement for briefing for new facilities, apart of involvement in design workshops and simulations. Another method, which was not tested in this case, is evaluation of buildings in use. All relevant methods could be described and results compared. The questions to be answered are: Which methods could improve the design processes with the ambition of creating better and innovative buildings of enhanced usability? What would the optimal process look like?

4.2. CASE 2 BISPEBJERG HOSPITAL, Denmark

This section presents the case study, which I also described in Paper A, Paper 4 and Paper 5. The first sections give a general description of the case and data collection. Next sections describe the processes and results of user involvement and briefing processes. Last section summarises the learnings.

4.2.1. Case description

Bispebjerg hospital formed my case study in years 2010-2012, which I also have described in Paper A, in a Danish professional journal “FM Update”.



Figure 24 Bispebjerg Hospital, garden and sculpture, site visit 2011

The Bispebjerg Hospital project consists of two parts: the New Somatic Hospital and the New Psychiatric Hospital Bispebjerg, that are both located on Bispebjerg Hill in Copenhagen capital area. In the years 2014-2025 there will be built new 100.000 m² and rebuilt another 57.000 m² on the existing site of 26 hectares. Additionally there is a simultaneous merging process with another capital area hospital – Frederiksberg, which will be relocating to the same plot of land. Additionally the Copenhagen Psychiatric Centre is also part of the project. A major part of the capital's psychiatry services will thus be gathered and highly specialised, while the hospital will also serve as an acute and regional hospital for the city, i.e. the suburbs of Bispebjerg, Brønshøj-Husum, Nørrebro, Vanløse and Østerbro and the city centre and Frederiksberg Municipality, thus serving for a total of around 450.000 residents.

The vision driving expansion of the hospital and psychiatry is “to create a place which promotes the well-being of patients, family members and staff in an aesthetic environment consisting of historical and new buildings and green areas. The area will become a health district in the future city – a park for recreation and healthy, preventive activities for present and future patients” (Danske Regioner, 2012).

EMPIRICAL STUDIES

The original Bispebjerg Hospital was designed by Martin Nyrop, who also is known for designing the Copenhagen City Hall. The hospital was built between 1908 and 1913 on the basis of a pavilion typology. The historic value in both architectural and cultural terms is worth preserving, thus a large number of buildings have been heritage listed



Figure 25 Bispebjerg Hospital, Picture of the site and winning proposal of the masterplan competition, illustration BDP



Figure 26 Left: Bispebjerg Hospital, existing listed building and garden, right: Claes Brylle Hallqvist, Executive Vice President at Bispebjerg Hospital, photos: Claus Peuckert

At the beginning of this major project it was decided to make a master plan competition, which forms the basis of the local plan and further architectural competitions for sub-projects. Several initial preparations for the master plan competition were made in the

form of expert studies of the site, buildings and organisation and later the briefing process (creating program of requirements) in 2010-2011. The competition program is organized along seven main subjects - the focus points (see section 4.2.3).

Furthermore, there was a user involvement process with six HIB groups (Hospital Innovation Bispebjerg groups), which had a series of three workshops each (see section 4.2.4).

In November 2011, the masterplan competition for the entire site was launched and in June 2012 the winning project proposal was announced, created by British company BDP in collaboration with architectural firm TKT and Rambøll Denmark, see a picture of the proposal in Figure 25.

4.2.2. Data collection

In the period 2010 – 2012, I conducted Case study 2 at Bispebjerg Hospital (BH). Particularly I followed the processes of user involvement and programming for the master plan competition. Furthermore, I conducted interviews with managers from the project group, i.e. with Claes Brylle Hallqvist, Executive Vice President at Bispebjerg Hospital (Figure 26), as well as with architects and workshop facilitators who were involved in programming and user involvement processes. A detailed list of the workshops, meetings and interviews in this and other case studies is available in APPENDIX.

4.2.3. Masterplan Competition briefing

At the Bispebjerg Hospital case there were many companies involved in the analysis, briefing and user involvement, which created an extensive data collection and preliminary analysis. The involved parties were architect companies, urban planners, time / process managers and municipal representatives who participated in some briefing meetings. The hospital building client organisation was looking for and chose the best experts, but subsequently there was also some tension between the parties and power struggles occurred along the way in the process. Some companies were innovative, others conservative and the companies insisted on their role in project. Still, the process went smoothly and created expected results, according to the participants and interviewees.

Furthermore, the client project team has made many visits to other places in the world to get inspiration for architecture, solutions in hospital buildings, interiors, parking and processes in hospitals, such as logistics. There are many good examples around the world, but according to Executive Vice President at Bispebjerg Hospital, Claes Brylle Hallqvist, there is no place that is a “world class hospital on everything, but every place is really good at one thing” (Hallqvist interview, 2012).

The briefing process has evolved over time, finally consisting of visions for the seven focus points, which gave the structure of the competition programme: the fantastic Bispebjerg, the human Bispebjerg, the integrating Bispebjerg, the accessible Bispebjerg, the effective Bispebjerg, the flexible Bispebjerg and the preventive Bispebjerg. For each topic the

requirements and desired outcome is described, but also the dilemmas that were found by management and user groups.

I give three examples of a dilemma from competition brief at BH. A dilemma: “BH requests stronger connections between the functions specified in the clinical structure in order to create optimal working routines for employees and appropriate patient care (...) good access to major functions must be provided, whilst maintaining the hospital area as an attractive, open, green space that can be integrated into the surrounding city”. Another dilemma: “How can the design achieve a clear separation between the entrances to both emergency units, ensuring privacy and high security for emergency patients who arrive via ambulance, and peace and safety in the reception areas for patients who are self-admitted?” Third dilemma: “How can we ensure easy access to the site by car and provide adequate parking, without having car traffic dominate the site experience?” (The Bispebjerg Project, 2011)

4.2.4. Interconnection between briefing, evaluations and user involvement

Bispebjerg Hospital is a fine example of the interconnection between briefing, evaluations and user involvement, which have been interconnected processes. The successful experiences from user workshops were used directly in the competition program: quotes from the users, dilemmas between the wishes and the hospital's basic structure. Moreover, in the context of Bispebjerg Hospital-case, a continuous briefing has been used, at least in the phases that I observed. Unlike traditional briefing, where some of the consulting experts write a program in the first building phases, with no user involvement and ongoing adaptation, the continuous briefing happens in a way, where the client continuously involve their own organisation, but also continue to work with the programme in the next phases, with other focus or level of detail, as presented in Figure 11.

In the period of Spring - Autumn of 2011 there were preparations for the master plan competition in form of various evaluations. There were for example several preliminary expert studies of the site, buildings and the clinical organisation. Another example is that all meeting rooms, offices and waiting rooms were visited every two hours by 20 students for a period of over two weeks. They opened doors and counted how many people used the room. The conclusion was clear: the spaces were not used as much as expected. Especially waiting rooms and meeting rooms were not used very much. The information withdrawn from those evaluations was used directly as data for the further development of a competition brief/program.

The program for the masterplan competition is organized into the seven focus points listed in section 4.2.3. The starting point for the focus points were the discussions at the user groups with same seven names and their three workshops. Each focus point gives the description of both the task and the known dilemmas. Furthermore, *Narratives* (story telling) were used as citations from user groups, when describing the future hospital.



Figure 27 Workshop with users, standing from left Pernille Weiss Terkildsen - Archimed, Aneta Fronczek Munter – PhD student , Claes Brylle Hallqvist - Executive Vice President BH

4.2.5. Workshops with users

In connection with the masterplan briefing competition in 2011 there was a parallel process of user involvement in the form of workshops. There were many interesting topics that structured the HIB groups - Hospital Innovation Bispebjerg that eventually developed from 3 to 7 items, focus points, as previously described. The process of user involvement consisted of six HIB groups, which met at 3 workshops each. The process was short and efficient with only three workshops in each HIB group. Workshops with users have been inspiring with eager and open participants who think of future needs and communicate their thoughts openly.

There was also a special group - *The Continuous User Group* - which continues throughout the hospital project's various phases. The group members were appointed by the Construction Steering Group and consisted mostly of Senior Hospital Physicians and Heads of Departments. The group gives continuity throughout the project phases and is involved in both strategical and operational way around the major decisions. It draws up guidelines for the entire hospital project and continuously evaluates the process. The purpose is to maintain the visions and agreements from previous phases and assist in the new proposals. The user group consists of about 15 employees covering Frederiksberg Hospital, Bispebjerg Hospital and, where appropriate, Psychiatry.

There was also a new idea about the 'young generation group' which was planned for later phases where they can affect the design directly, but the idea is not finally approved yet. Another present group is a citizen council, where people of all age groups provide input to the hospital. It will be interesting to follow the results of these processes later.



Figure 28 One of the first HIB user workshops, Continuous user group, photo: Louise Bendixen



Figure 29 Bispebjerg Hospital user workshop, photo: Karen Grønkjær

There were generally many different types of users in HIB workshops; mostly clinicians but also a few patients. Workshops were planned and run by both internal and external facilitators. The organization of workshops and choice of facilitating methods was made by the internal hospital project building client organisation and external architects. According to Executive Vice President of Bispebjerg Hospital, Claes Brylle Hallqvist (interview June 2012), the main reasons for the user involvement were: 1) getting the user's knowledge incorporated in the competition programme, 2) to create ownership and goodwill to the project and to make decisions. Other reasons, like getting visions /ideas from the clinic employees, or to confirm own ideas, were less important.



Figure 30 Workshop with user group discussing the patient of the future

User groups have produced results which fit with targets. Users have given their knowledge to the competition program, also in innovative ways. They contributed with texts and quotes for vision and the focus points. They made visible dilemmas between different wishes and visions for the future hospital, which became an important part of the competition programme. They have collected and created the clinical architecture within the “molecular model”, see Figure 31, a 3D model with clinical units and strong and weak relations between them. It was intended to be a tool for the project architects to think and plan, but simultaneously it turned suitable for the marketing of the project. Last, but not least, the user groups have added specific, practical wishes and requirements for the future buildings. In general, user involvement at the Bispebjerg Hospital case has been fast and impressively effective, according to participants and project management group.

4.2.6. Summary and conclusions from BH case

This Bispebjerg Hospital case is special by showing the potentials of impressively effective and open processes of briefing and user involvement in big healthcare projects. We can learn several things for other similar processes in other building projects.

First of all, we can learn from good experiences with users, they were invited to a series of 3 workshops, with ambitious goals, but restricted focus and power, so they could talk openly and efficiently collect ideas, knowing that not all of them will be satisfied in future project. In fact they got aware of the dilemmas and took them directly to the brief, to give an open challenge to the project participants that could give innovative solutions to the task. The process was therefore short and effective, unlike other cases abroad, that didn’t use expectations management; see Case 3 in section 4.3. The groups, especially the continuous group was securing a continuous communication and feedback during the briefing process, which if continued same way through next phases will show the potentials of continuous briefing process, as literature suggests.

In addition to this, there are several types of briefs, but overall they can be divided into two contrary types. On one side, there is the *hard type of brief*, which is very prescriptive and detail oriented, with lists of demands, facts, overload of data, hidden contradictions and IT systems, which maintain all requirements with details. On the other side, there is the *soft type of brief*, which is vision oriented, telling the story of users' needs, and showing its dilemmas. Of course, most briefs will be somewhere in between these types, but Bispebjerg Hospital project tells a story with their quotations from user groups and showing the dilemmas, therefore it is closest to the soft brief. The openness of the dilemmas in briefing meant that all of the vulnerabilities of the wishes and desires are shown, but at the same time, there is also a new space opened up for unknown, innovative solutions.



Figure 31 Workshop with users and molecular model, photos Karen Grønkjær

My evaluation of the competition brief for Bispebjerg Hospital is that they have chosen an appropriate type of briefing with user involvement and which performed well. A brief - that was daring to be more open, rather than just making demands and developing lists and specifications. A brief - that was speaking openly about both the wishes and the dilemmas. Thereby it was allowing innovative solutions for the future hospital.

For the next building phases at Bispebjerg Hospital project and the processes of user involvement and briefing I hope to see the continuous briefing develop further and wish that they can learn from cases in Norway about involving more patients and from the Danish HIL case, about innovation with users as co-creators. I would propose future workshops to enable users and designers to co-create. I would also propose choosing focus areas for user groups or each workshop and staying open in the writing of brief. I also propose trying different facilitation methods, design games and simulations, as I wrote in Paper 3, inviting more types of users and inspiring them, learning other ways of layout and working procedures at other sites and co-creating new solutions, thus enabling innovation.

4.3. CASE 3 ST. OLAVS HOSPITAL, Norway

This section presents the case study, which I also described in Paper 4 and 5. First sections give general descriptions of the case and data collection. Next sections describe the processes and results of user involvement and briefing processes as well as a test of USEtool walk-through evaluation method at Laboratory Centre. Last section summarises the learnings.

4.3.1. Case description

St. Olavs Hospital (SOH) is the new regional university hospital for the Mid-Norway health region, built in Trondheim on an existing hospital site in the years 1994-2014. The first clinical centre was completed in 2005. Recently (2014) the hospital received a total of seven awards at Design & Health International Academy Awards in Toronto, Canada.

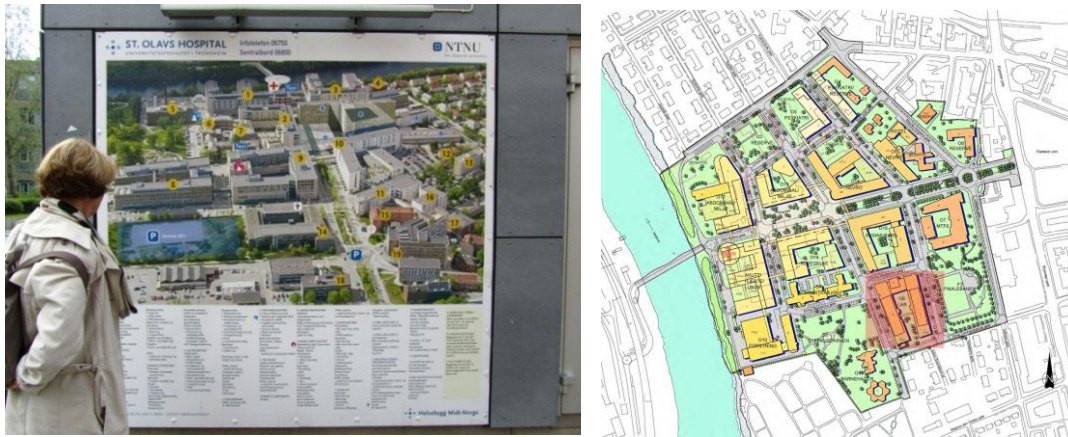


Figure 32 St. Olavs Hospital, overview of the site and buildings, photo left: Aneta Fronczek-Munter, photo right: Ragnhild Aslaksen

Considered by the judges to be at the leading edge of innovation in terms of both its adoption of digital technology, its approach to health promotion and the way the hospital design had been integrated with the city, St Olavs was judged to be the overall winner of three categories, including International Health Project (over 40,000 sqm); International Salutogenic Design; and Product Design for Healthcare Application for an interactive digital installation that assist patients and families to educate themselves about their health. The hospital was also highly commended in the category, Use of Art in the Patient Environment; whilst its specialist Knowledge Centre building received high commendations in Sustainable Design and Interior Design (The International Academy for Design and Health, 2014).

4.3.2. Data collection

Personally, I participated actively in this case study 3 while the Hospital was nearly fully completed. Therefore, data in the case study at St. Olavs Hospital was obtained in three different ways:

EMPIRICAL STUDIES

1. Historical study of literature and document reviews
2. Semi-structured personal and mail interviews, which I conducted in 2012-2013 with Chief Architect at Hospital
3. Development Project for Central Norway (Norwegian: HBMN – *Helsebygg Midt-Norge*), Ragnhild Aslaksen and Chief Medical Manager, Liv Haugen, who were responsible for user involvement in the project, see the list of interviews and topics in appendix.

Site visits to the St. Olavs Hospital in November 2012, where I also tested a method of building evaluation, USEtool on one hospital centre –Norwegian: *Laboratoriesenteret*, with architecture students from NTNU.



Figure 33 Pictures of St Olavs Hospital, exterior and interior.

4.3.3. Processes of briefing, design and user involvement

Nesje (Nesje, 2006) described the early process in planning and building of the new hospital, from visions to realities during the building process. The vision for the St. Olavs Hospital has been to be one of the most innovative in Europe. Therefore the goal for the design team was to design the hospital from scratch to fulfil patient needs. The patient

treatment is untraditional and “the Centre Model” is a basis of the winning design proposal, with several buildings (centres). Each Centre has focal points for the related medical treatment. The buildings, surroundings, equipment, treatment and nursing is based on what best serves the patient. There was a slogan “better services at lower cost” aiming at reducing operational budget by 100 million NOK compared to existing, old-fashioned hospital, by building new space- and cost-efficient buildings and modern medical treatments with shorter stays for patients.

The whole hospital was built in two main parts (not building phases). Part 1 took place in the years 1994-2005 and included five buildings: Laboratory Centre, Women and Children Centre, Neuro Centre, Suppliers’ Centre and a Patient Hotel. Building Part 2 took place in the years 2005-2014 and consisted of Abdominal Centre, Environmental Centre, Emergency Centre, Cardiothoracic Centre, Mobility Centre and Psychiatric Centre. At the same time more than 80% of existing hospital buildings were demolished.

The planning process and project management described by (Nesje, 2006) include making several briefing documents by the HBMN – Hospital Development Project for Central Norway. There were mandatory briefing documents as a *technical brief*, *environmental brief* and *aesthetic guides*, as well as *design criteria* and *concepts*. The briefing process and results are summarised: “The management for planning and building (...briefs, red.) have improved the technical standard and reduced the risk of failure and bad workmanship” (Nesje, 2006).

Each of the many centres in Part 1 had a separate project team with own architects and consultants, which ended up with a considerable variations also in the technical systems, which might be more cost intensive. The goals to reduce energy were not fulfilled completely, as “the cheapest energy is the one you never use” (Nesje, 2006). Nevertheless the environmental brief put more focus on sustainability through both the choice of materials, energy efficient buildings, reuse of existing materials and reducing the inconvenience for the existing hospital and the surroundings.

The lessons learned from Part 1 were taken to consideration and some processes improved in Part 2. In Part 2 the design and construction was organised as partnering, with higher involvement of suppliers with the goal to improve quality. Four new centres were this time organised in one contract and all partners located in the same building during design (Nesje, 2006).

Olsson (interview, 9-06-2011) indicates that there was minimal or no user involvement in Part 1, where the belief was that experts innovate better than users and are professionals. The users subsequently indicated that these proposals were not what they needed. On the other hand, in Part 2 they went to the other extreme and there was “too much user involvement” (Olsson, interview, 9-06-2011).

According to the Chief Architect – Ragnhild Aslaksen (interview, 2012) there were extensive amount of user involvement, with over 1025 workshops in Part 1 and 2. The users were defined as patients, but there was a process of employee involvement as well.

Olsson et al. describe the process further: “especially hospital staff (including nurses) got tightly involved in the planning as professional user representatives. The involvement got so far that one could question whether the representatives were the user’s representatives in the project, or the project’s representatives towards other users”. Furthermore “future facilities management personnel were also involved in planning” as well as patient representatives, who were “involved, mainly through patient interest organisations, but in some occasions also as individuals” (Olsson et al., 2010).

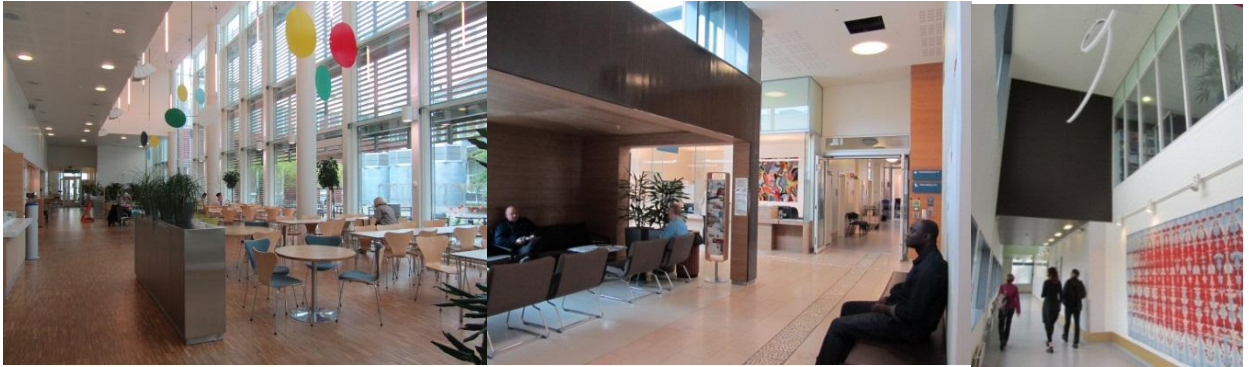


Figure 34 Interiors at St Olavs Hospital

Unfortunately, even after such an extensive process, the employees were not satisfied with the finished hospital buildings, because it did not implement all their wishes, discussed at the workshops. (Aslaksen, 2012; Olsson, 2011) The employees did not feel much ownership of neither the process nor the concept nor the result. Therefore, there were implemented some changes in the process, where the involved patients and specially the medical employees were informed about what kind of process they are part of, and what kind of expectations they might have and finally, that not all of the wishes are realistic.

In general the results of user involvement in both parts were a better hospital, for both patients and staff (Aslaksen, interview, 2012). The Chief Architect finds that in user participation “the patient organisations are important, and totally changed the results”, but there is “enormous blindness” in the practice for the advantages of it and possibilities of innovation (interview 07-06-2011, 01:04). In another interview she emphasised the good experiences with patient involvement and some of their results, as single bedrooms and better privacy, which are typical hospital problems (interview, 14-09-2012). She added though, that at the user workshops at SOH they experienced some problems with hierarchy issues between participants during discussions (interview, 14-09-2012, 02:34).

Both the researchers and the Chief Hospital Architect mention the importance of the *Planetree* philosophy regarding patient focused hospitals, for this hospital project. The *Planetree* was mentioned in section 3.5.3.

Jensø and Haugen (Jensø & Haugen, 2005) describe the SOH case and ask if the patient focus is leading to improved usability in hospital buildings. They describe a number of challenges to usability and the patient focused hospital:

- extensive involvement of different actors, having different perspectives on usability of buildings,
- unknown connection between the involvement of the users in the planning and the resulting usable buildings,
- relationship between efficiency and a patient focused ideology, and their compatibility



Figure 35 Exterior facades, garden and street view

4.3.4. Evaluations with USEtool

I have conducted a test of parts of USEtool at Laboratory Centre (Norwegian: *Laboratoriesenteret*) at St. Olavs Hospital, Trondheim, Norway as part of a PhD course “Evaluation of architecture” at NTNU in November 2012. I guided a few co-students from the course for a walk-through at Laboratory Centre, see Figure 36. I planned the route in advance, with the stops marked on the floor plan, see Figure 37, where we observed the focus points Aesthetics and Usability, made notes and discussed our analysis. Finally, I made an additional pilot test of a *survey* from USE tool at 2 locations.

The results of USE tool were: broad overview of the facility, structured observations and group summary, but also surprising additional information about usability from user

questionnaire. Our initial observations were structured by choosing the focus points and filling out summary forms from USEtool, see Figure 40.

As an example of our observations one of the stops, the entrance hall - stop nr.2, in the evaluation is described. See Figure 37 and Figure 38.



Figure 36 Laboratory Centre at St. Olavs Hospital. Left) main entrance Right) Detail.

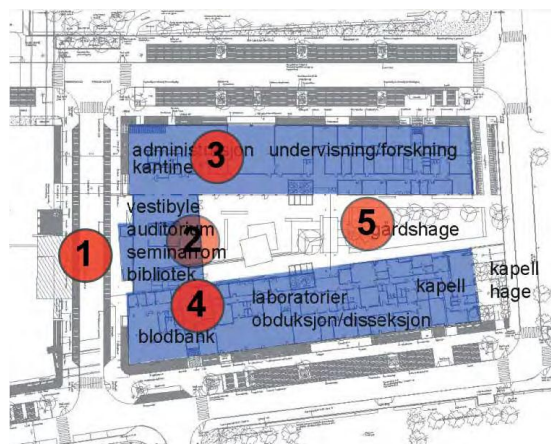


Figure 37 Floor plan of the Laboratory Centre and planned stops

There, while observing the Aesthetics and Usability, the students and I noticed the spaciousness, admired the light and compositions in space, found the materials as visually pleasing and of high quality. We were examining the attractiveness for employees and patients, ease of orientation and access for the visitors/patients and the paths they need to walk. We noticed the welcoming information and reception desk and found it well designed, welcoming /open and appropriate for the task.

Our notes include:

- 1) Always possible to find this space again,
- 2) Variation of materials, texture, colours, attractive, concrete ceiling,

- 3) Space, grand scale, size of vestibule, airy, well lit, attractive design,
- 4) Transparent – helps to determine location,
- 5) Reception- easy to find, attractive, daylight, glass, design.

Therefore we were surprised, when in the next step of USEtool – the user survey, the women working in the reception pointed to a number of problems with usability of their workplace. We explored the topics further by asking additional questions at the site.



Figure 38 Laboratory Centre at St. Olavs Hospital, Entrance hall and reception

First problem was the cold and draught. While the reception is welcoming the guests with openness, it was too open to maintain a decent work temperature in winter, as the big entrance hall is only heated in a limited extent. All the visitors pass the entrance hall in winter jackets and do not experience problems. The original design did include local heating, but turned out to be insufficient. Even the later addition of glass partitions in the reception didn't solve the problem completely. There were other issues as well, for example noise, too open design/ no privacy, bad indoor climate, not suitably designed and insufficient storage space.

The employees gave positive remarks as well, three most positive were:

- The building profiles our company in a positive way,
- Our premises have an attractive design,
- Feeling of belonging

It can be concluded, that for a full overview, observations must be followed up by questionnaire filled at site by employees, as it gives additional information, which might be overseen by people not using the spaces regularly. The evaluation was not part of the hospital project. It must be noted that the process was not a full USE tool test, but only parts of it, but it gave valuable inputs, that could be used for briefing of other hospitals.

4.3.5. Summary of SOH case

The case of St. Olavs Hospital was actively using the Planetree philosophy in order to achieve healing architecture, with focus on the patients. The patients were involved, along with the employees, and they actually affected the final results in the hospital, as it was the case with the choice of single patient rooms. The case is an example of extensive user involvement process and with both positive and negative outcomes of managing the expectations and hierarchies in the process. The users are seen as a complex group, with multiple types being involved in the design decisions in the hospital.

In addition to expert interviews and site visits, I also actively tested the USEtool evaluation method at Laboratory Centre, and studied historical reports covering past years of the project.



Figure 39 USEtool steps, the test contained step 1 and 3.

SUMMARY OF FINDINGS FROM THE WALK-THROUGH at Laboratoriensteret St. Olavs Hospital
Planned, conducted and summarised by: Aneta Fronczak-Murter, PhD student, Architect M.Sc.
Participants: Aneta + 2 architecture students following the courses Evaluation of architecture/ Environmental Aesthetics at NTNU
Date of walk-through: 2012.11.02

STOP 1 - The front facade and entrance
Interest group A - Architecture students

Positive observations

1. Special design draws attention to entrance, easy to see - big scale architectural form and signs with name, public buildings wants to be visible
2. Choice of materials: good variation of forms, attractive materials (bricks, gray pattern, wood glass), colour, details (windows, facade materials), materials are of high quality, natural
3. Openness, see through the building, nothing to hide, see garden/courtyard - green trees (inviting to get in the atrium)
4. Easy to see from outside where the public and private zones are
5. Open corridor between buildings: activity

Negative observations

1. Entrance: entrance from two sides, wheelchair and stairs (if you come from left side, seems impossible to access, stairs, hidden ramp, "where are the doors?", small scale if approaching from left only a small sign saying laboratorie, big sign only visible when you turn)
2. Signs too small: "Laboratorie center" big, but "Blood giving" small
3. Colour: just as expected, nothing new, dull Scandinavian (gray, bricks, wood)
4. Parking on street (positive and negative)
5. Industrial materials - brick finish looks older than it is
6. Missing bench by entrance visible from outside

Selected topics:

1. Attractiveness for employees (Aneta + image/aesthetics)
2. Attractiveness for patients/blood donors (Aneta + image/aesthetics)
3. Ease of orientation (Aneta + image/aesthetics, signage, colour)

Image aesthetics & facade design attractive
Image & facade design attractive
Easy to find building, hard to find entrance

Suggestions for improvement

- Entrance solution (for another hospital building):
 1. One entrance for all in the middle and in the front (universal design, also wheelchairs in main entrance), more open entry
 2. If entrance from side, then with stronger colour inside - better visible
 3. Seating area by entrance
 - Some evergreen trees in the courtyard too keep the green all year (but will damage openness/visibility through/corridor)

© NTNU / SINTEF 2011 USEtool - Stage 3 - Walk-through - support tool 3c Made by Aneta Fronczak-Murter, PhD student, Architect

LABORATORIESENTERET

© NTNU / SINTEF 2011 USEtool - Stage 3 - Walk-through - support tool 3c Made by Aneta Fronczak-Murter, PhD student, Architect

MAPPING QUESTIONNAIRE
USEtool, EVALUATION OF USABILITY

How strongly do you agree with the following statements on a scale from 0 to 5, where 0 = disagree, 1 = slightly agree and 5 = highly agree

WORK PROCESS SUPPORT

1. The premises support our intended support our teaching
Scale: 0 - disagree - 5 - highly agree
2. The premises help us to work efficiently
Scale: 0 - disagree - 5 - highly agree
3. The premises provide a good work environment/learning environment
Scale: 0 - disagree - 5 - highly agree
4. The premises facilitate communication within our group and
Scale: 0 - disagree - 5 - highly agree
5. The premises facilitate cooperation with colleagues and colleagues in practice
Scale: 0 - disagree - 5 - highly agree
6. The premises help me to learn from others (support knowledge sharing)
Scale: 0 - disagree - 5 - highly agree
7. The premises support the development of knowledge
Scale: 0 - disagree - 5 - highly agree

Other comments:

SCALE: WORK PROCESS SUPPORT
(Questions 1-7)

FLOOR PLANDISIGN

8. The rooms are used as available and we have ready access to them
Scale: 0 - disagree - 5 - highly agree
9. The rooms are suitably designed
Scale: 0 - disagree - 5 - highly agree

© NTNU / SINTEF 2011 USEtool - Stage 3 - Mapping - support tool 3b

Figure 40 Example pages from USE tool case report, stop 1, notes, pictures, survey and summary, all stops had same structure of analysis and reporting.

4.4. CROSS CASE ANALYSIS

The case studies are quite different and complementary on a number of parameters. The following sections explain the similarities and differences between the cases and the conclusions from them form the new model for usability briefing and the suggested activities, which are described in more detail in chapter 5.

4.4.1. Table comparing the case studies

The three case studies are compared in Table 8 and in Paper 5. The differences are in the studied phases, research methods, activities observed, user types and tools - boundary objects.

Table 8 Overview of the three case studies and the differences, adapted from Paper 5

Name	Case 1, Denmark Healthcare Innovation Lab (HIL)	Case 2, Denmark Bispebjerg Hospital (BH)	Case 3, Norway St. Olavs Hospital (SOH)
Building phases studied (RIBA)	1 – Preparation and Brief, 2 – Concept Design	0 – Strategic Definition, 1 – Preparation and Brief	0-6, 7 – In use
Research method	Planning, participation and evaluation of workshops with users (medical staff), observation, video recording and active participation in activities	Observation of workshops with users and work meetings about briefing, interviews with managers, architects and facilitators	Phases 0-6 as historical study from literature and own interviews, Phase 7 – In use - as trial of evaluation method USEtool on one department building
Activities	User involvement, Briefing, Design, Evaluation	User involvement, Briefing, Evaluations	User involvement, Evaluations
User types involved	Lead users: medical staff including doctors, nurses and medical secretaries; patients – seldom Facilitators / participants: researchers, consultant companies and various specialists.	Medical staff, patients continuous user group, lead users, 6 thematic user groups	Phases 0-6: patients, relatives, patient organizations – as users, medical staff (nurses, doctors)-as employees, architects – key people Phase 7: architecture students, researchers and medical staff

Name	Case 1, Denmark Healthcare Innovation Lab (HIL)	Case 2, Denmark Bispebjerg Hospital (BH)	Case 3, Norway St. Olavs Hospital (SOH)
Tools, boundary objects for user involvement, briefing, design	User driven innovation, participatory user workshops, design games, for example Ovals with poster and print, icons, Lego figures, drawings	Discussion, brainstorming presentations, document writing workshops with facilitators, graphical posters, physical 3d model objects, drawing, discussing	0-4: Multiple user workshops – challenges and solutions, discussion, test models
Evaluations, user involvement	Simulations, cardboard boxes for rooms, typical patient processes, Lego figures, timer	Counting use of rooms during day, inspirational site visits	5: Functional site visits 7: USE tool: planning, walk through and stops, photos, observations, drawing, discussion, notes, filling out schemes, survey and interview, summary evaluation of results

4.4.2. User involvement, briefing and design in the case studies

As I wrote in previous sections and Paper 2 and Paper 5, there are different users and different boundary objects - tools, which can be applied for user involvement in building design projects, specifically for hospitals. I here compare the three cases and their processes of user involvement, briefing and design.

Case 1 - Healthcare Innovation Lab

Case 1 HIL was a showcase of a short and effective user involvement, where methods of user-driven innovation were tested. The many new methods, like design games, mapping and rapid table simulations gave excellent results, both in the form of different configurations of typical hospital ward and by providing an overview over which methods work well in the hospital sector and in relation to the clinical staff. Unfortunately, the results could not be used in connection with the parallel architectural competition at Herlev Hospital, as the timing of the process was wrong.

Case 2 - Bispebjerg Hospital

Case 2 BH shows the potentials of effective and open processes of briefing and user involvement in healthcare projects. BH case is a fine example of the interconnection between briefing, evaluations and user involvement, which were interconnected processes. The successful experiences from user workshops were used directly in the competition program. The users participated in a series of 3 workshops, on one of seven focus areas, with ambitious goals, but restricted focus and power. There was a special

continuous user group to secure continuity in the following phases. The users found and retained dilemmas, which were used in the briefing, aiming at receiving unknown, innovative solutions. The successful experiences from user workshops were used directly in the competition program: quotes from the users, dilemmas between the wishes and the hospital's basic structure.

Case 3 - St. Olav's Hospital, Trondheim

In Case 3 SOH we see extensive user involvement, with over 1025 user workshops. Nevertheless, the number covers all building phases throughout the construction period, and not just the briefing phase. In the first part of the hospital project, they were not managing expectations, with the result that the staff eventually was not satisfied with the hospital, which received an International Health Project award in 2014. It is a beautiful hospital, but a disappointment to those involved, because it did not apply all the solutions from the list of wishes and requirements. One can learn from this mistake, as it was done in the next part of the hospital project where they created a clear framework regarding, what one might expect and which things that were to influence and which ones were not. Another important observation was the successful patient involvement, also of patient associations at St. Olav's Hospital. The hospital has benefited from their participation and the Chief Hospital Architect said (Aslaksen interview, 2013) that the patient involvement affected the project to become a better hospital for both patients and staff members. In Denmark some people involved in the hospital projects talk about the troublesome patient involvement and try to avoid associations that resemble political groups. We could learn something from the success in Trondheim by taking patient involvement more seriously.

From all the case studies we can learn that user involvement processes can assist designing hospital projects, but must be planned and managed carefully. You need to manage the length and objectives of the processes, selection of relevant participant types, balancing expectations for users and own organization. Additionally timing is important, the process must occur in proper time, so that you can manage to use own results in next phases and processes.

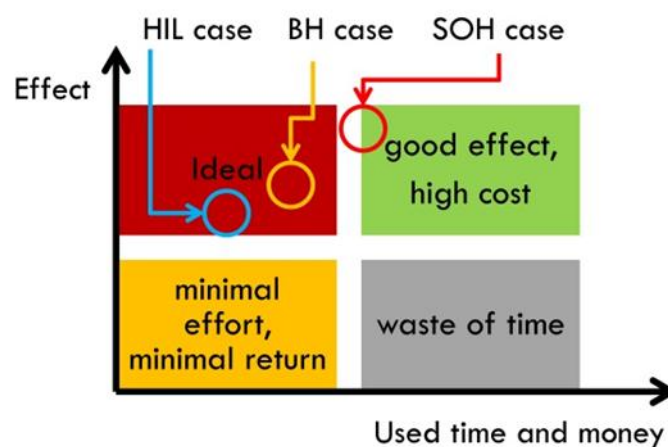


Figure 41 Diagram of the extent of user involvement and its impact, three hospital case studies

In Figure 41, you can see my placement of all three cases in a diagram of the extent of user involvement and its impact. **Case 1 HIL** was collecting strong results from a short process; unfortunately the process was not ideal, as the results could not be used for the competition brief, only as learning for the participants. **Case 2 BH** was also having a strictly planned user involvement with the groups meeting only three times each, they were also able to incorporate the ideas and wishes to the competition brief to new hospital. **Case 3 SOH** collected valuable input from many kinds of users, both medical employees and patients, which had a strong impact on the design of the hospital, which won international awards. Unfortunately the process required a large number of workshops and some groups were unsatisfied after all.

It could be summarised that amount and timing of user involvement processes and their connection to briefing and design must be planned carefully in order to reach the “*Ideal*” position in the graph.

4.4.3. Evaluations in the case studies

To show a sample of the varied use of evaluation methods used currently in hospital projects I present the results from the three case studies.

In addition to comparing the evaluation methods used in the three case studies I also present a proposition for appropriate evaluation methods in different building design phases, specific for hospital projects, based on literature review, see Paper 4 and section 3.4.5.

Case 1 Healthcare Innovation Lab (HIL), Herlev Hospital, Denmark

In Case 1 several evaluation methods were used. One evaluation method was a scenario-based table-top simulation, a series of evaluations of possible new spatial arrangements and working organisation. The simulations have proven to be both time efficient, easy to understand and use for all participants and very innovative in both process and results. The user group succeeded in developing an innovative concept of the future outpatient clinic in terms of spatial layout, work organization, knowledge sharing and technology.

This case has proven that evaluations can be one of the activities for involvement of users at workshops for developing new clinic facilities, but also that evaluation can lead to innovation.

The workshops took place while the architectural competition for new design of the hospital was running. I would propose using the simulation method either in the briefing stage to evaluate alternatives for the future or in the design stage to evaluate the preliminary sketch design solutions.

Case 2 Bispebjerg Hospital (BH), Denmark

One of the evaluation methods used in Case 2 was Study trips/excursions – a less structured walk-through process, where managers and client project group visited other

sites for inspiration. The focus was often one specific area i.e. logistics and the location were chosen as the best case within exactly that theme. Interesting cases were not only hospitals, but also other buildings: hotels, airports, to observe the best systems running smoothly. Another evaluation method was User patterns and space utilization, time/activity/space studies. These were run as preliminary studies of used and empty rooms, done by an external party and served as basis for area calculations. Both methods were used in briefing stage of the project.

Case 3 St Olavs Hospital (SOH), Norway, USE tool at Laboratory Centre

Case 3 was different than the other two cases. It was studied in a different manner, as I actively tested the USEtool evaluation method at Laboratory Centre. The results of a pilot test of USE tool were: broad overview of the facility, structured observations and group summary, but also surprising additional information about usability from user questionnaire. It can be concluded, that for a full overview the observations must be followed up by questionnaire filled at site by employees. The evaluation was not part of the hospital project. It must be noted that the process was not a full USE tool test, but only parts of it, but it gave valuable inputs, that could be used for briefing of other hospitals.

4.5. ADDITIONAL DATA COLLECTION

Information and data was collected not only directly from the three main case studies. Apart of the workshops and interviews with companies and organisations within case studies or in cooperation with them, I also made 47 additional expert interviews and workshops with professionals. Therefore all 140 events, e.g. interviews, meetings and workshops can be divided to three main categories:

- Case studies (beside observations and literature review): workshops and expert interviews with involved parties, including both the hospital and external consultants,
- Explorative expert interviews,
- Validation expert interviews and focus group workshop.

The first category was described in the previous sections with case studies. The next two categories will be described in section 4.5.1 and 4.5.2.

4.5.1. Explorative expert interviews and site visits

I conducted a number of preliminary explorative interviews to gain insider knowledge in the healthcare design field, hear about the praxis of involving users in hospitals, etc.

A list of all interviews and workshops is available in APPENDIX, a few examples of the organisations interviewed are following:

- The Danish Association of Construction Clients (DACC) –(Danish: Bygherreforeningen), i2p – workshop series about briefing

- Architect companies designing hospitals/doing briefing/involving users (except those in case studies)
- Engineering companies –hospitals, users, evaluations, commissioning
- Patient organisation
- Innovation companies, specialized in design or briefing for hospitals
- Medical doctors

During the PhD Programme there were also organised several short visits to the following cooperating Universities and Research Centres abroad:

- **Norway - Norwegian university of Science and Technology, Trondheim (NTNU), Faculty of architecture**

I made site visits and interviews at new hospital development Skt Olavs Hospital, Trondheim, which became one of my case studies, as well as dialogues with the research group about usability, the evaluation method - USEtool, as well as user involvement in hospital projects. Furthermore I took part in a PhD course: Evaluation of Architecture, where I studied and tested evaluation methods at the hospital. I made several visits to Trondheim: 6-11 June 2011, 13-14 September 2012, 27-28 September 2012, 01-03 November 2012 and made additional interviews by e-mail with the hospital management in 2013.

- **Finland – Aalto University, Helsinki, Built Environment Services Research Group (BES)**

In Finland I also made site visits and interviews at: Meilahti Triangle Hospital - part of Helsinki University Hospital (HUU), and office spaces in Helsinki. Furthermore, I had dialogues with the Usability research in BES research group with overview of their research topics: Usability and offices, Rebus-project and Propal, Usability and housing. We discussed briefing, usability, hospital architecture, green perspective and made a Usability methods workshop. The visit took place the 19-22 June 2011.

4.5.2. Validation expert interviews, CIB conference, Focus group

There was also additional data collection in order to validate and further develop the Usability Briefing model, which is introduced and explained in chapter 5. The process consisted of additional expert interviews, presentation and discussions at a CIB conference, and a Focus Group validation workshop. Both process and results are described in section 5.3.

5. USABILITY BRIEFING PROCESS MODEL

In this chapter I present a process model of Usability Briefing (Usability Briefing). The text describing the model is to a large extent based on Paper 5.

The model includes all building phases: from pre-design to handover and in use and can be applied on complex building projects. Usability Briefing is a continuous briefing process, combining the four interrelated activities of 1) briefing, 2) user involvement, 3) evaluations and 4) design. The model provides a visual overview of the four activities in all the building phases, so they can occur at the right time and support one another. The approach combines continuous and active user presence, co-creation, design and evaluation with various users, using creative boundary objects at workshops.

5.1. OVERVIEW OF THE VISUAL USABILITY BRIEFING PROCESS MODEL

The usability briefing process model will be introduced in general terms in this section and later in more detail. It combines the results and insights from the three case studies, expert interviews and literature.

The model is shown in Figure 42.

The development of the model has taken place by combining the five main theoretical concepts (see Chapter 3), with the case study findings. It has been an iterative process, in which theories were compared to practice and vice versa. Ideas came from reading and from the many interviews in the case studies. Furthermore, the interviewees were either participants in workshops or members of architectural and engineering firms that were involved in briefing process, planning and facilitating user workshops and simulations or the managers of the hospitals, that were responsible for the building projects and the briefing process.

Additional sources of inspiration were a series of workshops organized by The Danish Association of Construction Clients (DACC) (Bygherreforeningen), called From Idea to Program (i2p) in years 2010-2012. Furthermore, the model was based on RIBA's planning phases from 2013 (see section 3.5.4), as the backbone for the approach, chosen as means to connect to practice.

An earlier version of the model was presented and preliminarily verified at a CIB Facilities Management conference in Copenhagen (Paper B). Based on comments from conference participants, two additional expert interviews and a Focus Group workshop with 17 participants, the model was modified. In the new model the layers are reshaped, the model simplified for better overview. There is an additional arrow to show the repeated process and there is a table showing the focus, users and methods to be used at each

building phase. The details of the validation process and results are presented in section 5.3. The aim has been to translate the many different concepts and ideas that were found into a single, coherent model for Usability Briefing.

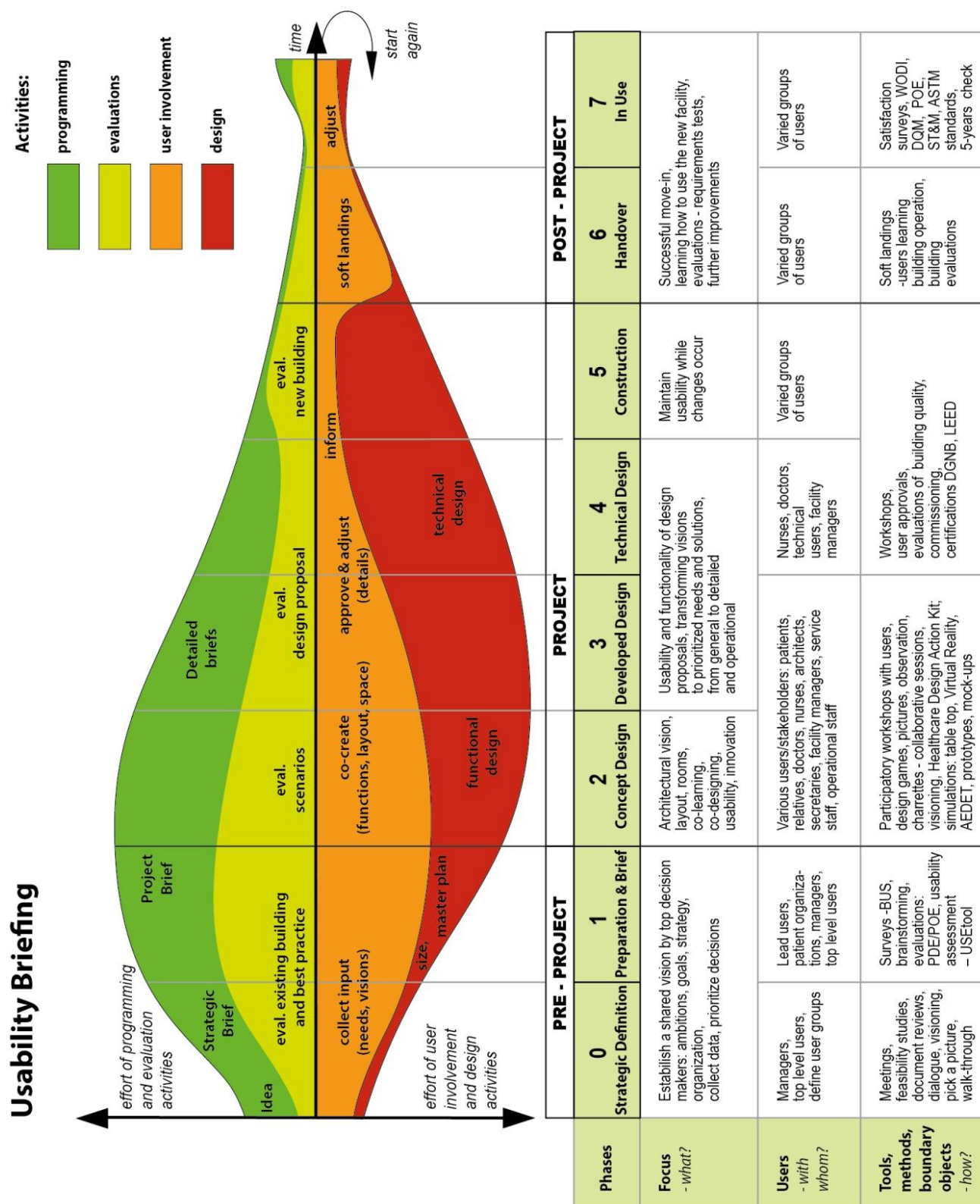


Figure 42 Usability Briefing process model

USABILITY BRIEFING PROCESS MODEL

The aim of the model is to give an easily understandable overview of the engagement over time in the different processes that can constitute Usability Briefing in the building design process. The four activities in the model are: briefing, evaluations, user involvement and design, each shown as a coloured layer. The model is based on the building design phases, numbered from 0 – Strategic Definition, to 7 – In Use.

There is an arrow showing circular and repetitive process, because hospitals usually exist before new building projects start and are rebuilt after some years of use and changes in technology and population age. The effort shown for the four activities are not to scale, instead the thickness of layers symbolizes increasing or decreasing effort.

The four activities are considered as essential for a good briefing process with a focus on usability. They are shown as separate grey shaded layers, added on top of each other, but they do and should interact with each other in each phase. While many professionals agree that briefing should be initial to and separated from design (Cherry, 1999; (Duerk, 1993), others are “skeptical about the assumption, that briefing is distinguishable from design” In this model briefing activities are distinct to design, but the border is fluid and weak, allowing for frequent, regular interaction (Duerk, 1993) between all the activities. The intimate connection between briefing and design, to the point that they become indistinguishable, is also suggested by Blyth and Worthington (2010). Nicholson (2010) says that briefing is a design process and you develop the brief through design.

The table below the model shows different focus, users/stakeholders and methods that are recommended throughout the project.

The premise of the model is that usability topics are explicitly being addressed in each of the 4 activities. It means that usability topics are formalized (e.g. in agendas, notes, documents), discussed (in workshops, design meetings) and systematically evaluated (e.g. in design appraisals). Furthermore, the idea is that usability topics are explicitly held on to when switching from one activity to another, avoiding that issues get ‘lost’ along the way. For example, if the issue of hospital bacteria comes up in early workshop with users, this issue should then explicitly be mentioned as a concern in the early briefing documents. These should then, at a later stage, be translated into detailed, testable specifications (e.g. concerning hygiene and cleaning). And next, during the design process, these should be used to systematically test (‘verify’) design proposals. In a feedback sessions with the users it should be explained how the design answers to their concerns. The usability focus shall therefore be kept throughout all the phases, especially before and during construction, where changes occur both by designers and contractors.

The model is developed to be generic and easily adaptable, such that it can be used for planning new complex building projects and include only some of the phases or activities that fit exactly that project.

5.1.1. Explanation of details in all phases

Phases 0 and 1 will be described in more detail, because of rich data from case studies covering those phases.

5.1.2. Phase 0 – Strategic definition

This phase is about transforming the idea and statement of need into definition of a *Strategic Brief*, the start of a building project (Blyth and Worthington, 2013; Arge and Blakstad, 2010; Nutt, 1993; Fristed and Ryd, 2004; Van der Voordt and Van Wegen, 2005). The focus is on capturing needs and visions.

The first step is inception of an idea, followed by collecting expert knowledge inside and outside of the organization, feasibility study, research, decisions about budget, size and location choice. For hospital projects parts of it are often a political process. The outcome is a Strategic Brief – a document stating main objectives of the project, the first visions and inspirations, as well as rough estimates/decisions about location, needs, size and time schedule. Oijevaar et al (2009) add definition of ambitions, demands and stakeholders and testing feasibility.

In the **BH case** much effort was put into collecting expert knowledge about their site and future possibilities from multiple research studies by external companies. Based on the case, I argue that it is important to base the important initial decisions on valuable and trustworthy data. Some of it may come from external studies and some from user involvement with internal users and evaluation activities.

In Phase 0 I propose that managers and top level users meet for a few workshops about stating the needs for the new project and estimating scope of the project. The input to strategic brief is about first visions, size and extent of project. This is time to start of a building client organization with connection to managers and users.

The idea is to find and select the lead users in this phase – advanced users because of position or special knowledge, as in the **BH case**. There, they quickly found lead users - medical staff at high positions i.e. department directors, who had strong visions and were discussing them together with top hospital managers and building client team. Furthermore, a continuous user group was established, a group of lead users, that meets regularly throughout the whole building process securing both management contact, advice to the building process and the continuity of solutions. In the **SOH case** the political context of "The patient in focus" defined the users to be patients' and relatives' organizations, whereas medical staff was not participating in "user-", but in "employee involvement".

Generic recommendations are to choose a varied team from patient organizations and medical departments to get the big picture, common understanding and visions. Possible boundary objects and tools are: prioritizing with *bull's eye* poster and discussions, feasibility studies.

Proposed evaluation activities are of two types: 1) Looking at previous experiences with building projects. 2) Evaluating existing facilities and organization, by collection of main facts about the organization and buildings, size and needs. The tools can be brainstorming, focus group interviews, archive documents study.

The **BH case** made two types of evaluations at this stage, which can be recommended to other projects and the generic model. The first was room counting of all existing rooms and their usage over the day, to assure that space is not empty and help to estimate the proper future needs of room types and amount of space. The other was study trips to other locations in the world to get inspiration to architecture, solutions in hospital buildings, interiors, parking and logistics.

5.1.3. Phase 1 – Preparation and Brief

Phase focus is on creating a *Project Brief* (Blyth and Worthington, 2013) based on the Strategic Brief from phase 0 and relevant information from experts, users and evaluations in order to strengthen the visions, clarify the data about the size, extent and form of project. The names in literature vary significantly, i.e. Project Brief is also called Functional Brief (Blyth and Worthington, 2010; Arge and Blakstad, 2010) or Design Brief (Roberts, 2010).

Briefing activities are strongly connected with user involvement and evaluation activities. All three processes are of high activity at this stage, with several work meetings, workshops and site visits. Outcome is a Project Brief – a document capturing more information and decisions about the project, i.e. location, functional and organizational needs, size, design and time schedule. Additional items to the program of requirements are listed by Oijevaar et al (2009) and include: architecture, interior, urban planning and landscape, building physics, acoustics, construction, installations, money, time, risk and quality.

Initial user workshops are focusing on capturing strong visions for the new facilities, such that they reflect on prioritized needs and can be accepted and followed by the whole organization and at the same time inspire the architects in next phases.

BH case had good experiences with highly effective lead users' workshops, which gave important input to structure and content of the master plan competition brief. It is suggested to continue cooperation with advanced users with special knowledge – lead users. The **BH case** exemplifies a short process, with just six thematic user groups, each having a different focus. The groups were invited to a series of three workshops, with ambitious goals, but restricted focus and power, so they could talk openly and efficiently collect ideas, knowing that not all of them will be satisfied in future project. In fact they got aware of the dilemmas and took them directly to the master plan competition brief, along their direct citations and a model of the whole hospital structure.

HIL was a showcase of user driven innovation with users as co-creators of new hospital architecture and organization. Innovation occurred in both areas at once. Many design games (Brandt & Messeter, 2004) and boundary objects were tested and some methods

and physical objects were found to be better than others to inspire users to innovate and be in a designing state-of-mind. Table simulations proved to be playful and highly effective.

The **SOH case** had many user workshops (1050). In the first part of the hospital project users were involved, however without expectation management. That resulted in the staff being unsatisfied with the hospital not meeting all their wishes, even though it received seven awards at Design & Health International Academy Awards in 2014, including best International Health Project.

On the other hand, **SOH** had a successful patient involvement, with 10% patients in user groups, both individuals and representatives from patient organizations. Moreover, patient input gave a lot of design solutions to improve the hospital, both for patients and staff, which would not have appeared otherwise. Other countries, like Denmark or USA unjustifiably consider patient involvement as a difficult process not producing results. It is possibly a matter of proper planning and preparation, unlike in **HIL case** project, where patients were involved, but only very short and in a different ways than other participants.

This thesis recommends organizing workshops to enable users, client and designers to co-create and choose focus areas for user groups or each workshop (BH). The continuous user group (BH) can be started at phases 0-1, securing a continuous feedback and continuity of solutions. Also recommended is to 1) try different facilitation methods, design games and simulations, 2) invite more types of users and inspiring them, learning other ways of layout and working procedures at other sites and co-creating new solutions, enabling innovation (See Anonymized for review, 2012, 2013b for more information).

5.1.4. Phases 2, 3, 4, 5 – concept design, developed design, technical design, construction

The Project Brief is further developed to *Detailed Briefs*, which can include *FM brief*, *Operational brief* and *Fit-out brief* (Nutt, 1993; Blyth Worthington, 2010; Arge and Blakstad, 2010; Fristed and Ryd, 2004). The focus in those phases changes from architectural visions, inspiration for innovative design and layout to prioritizing requirements and detailed solutions for internal building spaces and construction technology. Briefing, design and evaluation activities focus on maintaining usability, also while some changes occur.

As part of continuous involvement, users are involved first very actively as co-creators of spaces and functions, as well as evaluating scenarios in phases 2-3, thereafter in phases 4-5 to evaluate design proposals, usability and approve the solutions.

5.1.5. Phase 6, 7 – handover, in-use

For the phase 6 - Handover, both literature and practice see a need of a process of teaching users buildings' operation, so that the moving in the new building is successful and smooth. An example of such process is called *Soft landings* (Way, M. et al. 2014), designed to smooth the transition into use, which in phases 5-6 consists of preparations for

building readiness and provisions of technical guidance. Later, in phase 7 the aftercare and support are provided in the first few weeks of occupation. Aftercare is provided in years 1 to 3, with monitoring reviews, fine-tuning adjustments and feedback.

In phase 7 -In Use, after specific time, there might be a need to adjustments to fit the changing demands, and then all activities of briefing, design, user involvement and evaluation can be started again in an extent fitting the size of changes.

5.2. OVERVIEW OF THE TABLE IN THE USABILITY BRIEFING PROCESS MODEL

The following paragraphs will describe the table in the Usability Briefing process model and give more information about the users, methods and focus across the building phases.

5.2.1. Which users to involve and when?

The question which users to involve and when to do it is critically important to ask by the client organisation and the consultants. The model helps answering it by grouping different user types and assigning them to the different building phases.

The phase 0 - Strategic definition starts with a definition of user groups and appointing the top level users by the management. It is very important to plan the further user involvement and communicate the roles and milestones.

In the next phase 1 - Preparation and Brief you could invite both the managers, the Lead Users, patient organisations and top level users for the briefing, design and evaluations tasks. The activities have high intensity and efforts and collect needs, visions and information, and give input to the brief and design. The evaluations should be combined with user participation for deeper understanding of the site and future needs that can feed into the briefing and design processes.

The phases 2 - Concept Design and 3 - Developed Design are those where the user involvement activities are still of high intensity and where the users can co-create the future solutions. There will typically be focus on functions, layout and space and in evaluation activities the future possible scenarios can be evaluated. The users and stakeholders involved can be of various types, i.e. patients, relatives, doctors, nurses, architects, facilities managers, but also service- and operational staff. The most knowledge is gained where the groups are mixed, but it requires a skilled facilitator to allow all professions to be heard.

In the end of design phases (3 Developed Design, 4 Technical Design and 5 Construction) there is still user involvement but it changes character from very active and creative to adjustment of details, approvals and information from the client organisation and building site about the progress.

Right before and during the Handover phase (6), it is recommended to use the concept of *Soft landings*, where the users are invited to learn how to operate the building, a kind of active building systems manual. There the mixed group of users can learn for example how the ventilation system was designed and how to operate it.

In phase 7 –In use the users are still involved. There might be small adjustments necessary and the organisation might evaluate the building and user satisfaction.

5.2.2. Focus of each building phase

The focus is necessarily changing throughout all the building phases.

In first phases 0 - Strategic definition and 1 - Preparation and Brief the focus is usually on establishing a shared vision across the decision makers and management. Relevant data is collected and decisions must be prioritised.

In the design phases 2, 3, 4 the architectural visions first take general shapes and later are more detailed. The co-learning, co-creation and innovation can also be the focus, already in the beginning at phase 2 Concept design. Throughout all design phases and in 5 Construction phase it is important to keep the usability focus, especially when new ideas arise and changes occur.

In 6 Handover and 7 In Use phase the focus shall be a successful and flawless move-in and smooth occupation.

5.2.3. Methods to be used

There is a variety of methods to use in briefing, evaluation and user involvement activities, but some are worth recommending for specific tasks.

In phase 0 – Strategic Definition , apart of the usual feasibility studies and discussions, a few methods are mentioned, as *visioning* and *walk-through evaluation* of existing buildings and best practice to gain an overview and develop strategic needs into the strategic brief.

Similarly, in Phase 1 *Pre Design Evaluations(PDE)* can be made, and specially the USEtool, as described in Case 3 can give valuable results, that can be used in further briefing and design process.

Phase 1, 2 and 3 are seen as best to conduct *participatory workshops* with users, using *design games, simulations and prototypes* in *user-driven innovation* and *co-creation*, as exemplified in Case 1. Furthermore, evaluations can be done with same user group participants for *co-learning*.

In phase 4 and 5 the meetings and workshops are focusing on user approvals and adjusting details of technical design. Further methods include *evaluations of building quality*, further applying the certifications criteria fx *LEED*, securing that solutions fit *operational* needs.

In phase 6 Handover, the method of *Soft landings* is seen as appropriate, to secure successful move in of the staff and learning how to operate the building.

Phase 7 In Use is provided with additional tools as *satisfaction surveys* e.g. *WODI*, later 5-year check for further assessments of and possibly adjustments according to the needs of an organisation and users.

5.3. VALIDATION PROCESS WITH EXPERT INTERVIEWS, CONFERENCE AND FOCUS GROUP

5.3.1. Validation process

After collecting data from case studies and explorative expert interviews I developed a model of usability briefing that is combining the main propositions to focus areas of briefing, design, user involvement and evaluations. I presented the first version of the usability briefing model to three architectural firms, with which I conducted two expert interviews for validation and improvements: 1. Aarhus Arkitekterne a/s and 2. Aart Arkitekter and Arkitema, as part of CuraVita DNV consortium, in December 2013.

Thereafter, I presented the improved version of the model in a first version of Paper 5 at CIB Facilities Management Conference in 2014. After incorporating some of the suggestions from the conference participants, I developed a new updated version of the usability briefing model.

In October 2015 I organised a focus group workshop with practitioners in order to validate and improve the newly developed usability briefing model. The workshop focused on briefing/architectural programming activities in hospital projects, and how they can interact with activities of user involvement, evaluations and design. I have presented recent research results and case studies from my PhD study and a proposal for a new process model for usability briefing, which was subsequently discussed by the professionals, divided into three groups.

There were 19 participants, from different organisations, as follows:

- Hospitals and their client organisations: Rigshospital, Nyt Hospital og Ny Psykiatri Bispebjerg,
- Architecture companies designing hospitals and involving users: White arkitekter A/S, C. F. Møller Healthcare, Designcure , Birthe Just Tegneste
- Engineering consultant companies with hospital projects: Sweco Danmark A/S (previous name Grontmij),
- Innovation consultants to hospitals: IDEAbility ApS,
- University, researchers dealing with hospitals, Facilities Management, sustainable buildings: Technical University of Denmark, Management Engineering, Center for Facilities Management
- The Danish Association of Construction Clients (DACC) –in Danish: Bygherreforeningen

USABILITY BRIEFING PROCESS MODEL

The workshop proceeded as follows. First, professor Per Anker Jensen, welcomed the participants at Centre for Facilities Management. Then, I introduced to the workshop themes and made a presentation of current research status of the PhD project and introduced the Usability Briefing concept and process model, see

Figure 43. The workshop themes were:

- Architectural programming / briefing
- User involvement
- Design of hospitals
- Evaluations of buildings



Figure 43 Focus group workshop in October 2015, Aneta Fronczek-Munter introducing the main themes

I presented a couple of hospital cases and research results, stressing the four themes and the resulting combination of them in the new usability briefing process model. I explained the main ideas behind the model and how it can be understood and used. Then, the participants were divided to three groups, in a way that the colleagues from same company shall split to different groups.

The groups were given an assignment to discuss the model with each other professional experiences and reshape the layers in the model where necessary, make three suggestions for the model. Furthermore they were asked to think about how the model could be used at their work and what are the strengths and weaknesses of the model. The practical set up of the discussions was, that the groups were given a A0 print of the model, hanging at the walls, colourful post its and markers. They were given 45 minutes for group work.

While they were discussing and drawing at the model posters, I was taking pictures, recording the voices discussing and answering questions, see Figure 44. I was not giving my own opinions to their ideas, but was interested in hearing and understanding different views on the subject. It seemed like all participants were very interested and enthusiastic about the assignment, they were discussing with each other, drawing different lines, making notes and marking specific parts as important.



Figure 44 Focus group workshop, Aneta Fronczek-Munter and Group 1 discussing the Usability Briefing model

Finally, each group made a presentation of their solution and the changes in the model. The groups were having very different ideas, but a few of them were similar. Afterwards there was a general discussion of the ways the usability briefing model can be used at their work and specific strengths and weaknesses of the model.

I chose to incorporate the few common comments in the update to the usability briefing model. The results in the model will be described in following section 5.3.2.

5.3.2. Validation results

The validation process of the Usability Briefing model is described in previous section. The model was transformed and improved several times. The version presented at a CIB conference in 2014 is shown in Figure 45.

The outcomes from the initial validation expert interviews were adjustments to the four activities and their layer thicknesses, suggesting bigger effort. In general, the companies admired the idea of the model and could imagine and give examples of its use at their workplace, for example showing the planned processes to the client and giving overview to own and cooperating organisations. On the other hand, the companies were asking for a simpler version. At the same time we were discussing the details, even singular small hills at phase changes in the model.

At the CIB conference, the participants could see the influence of my architectural background, with one-off projects and were suggesting showing, that for organisations, the project usually start again after the phase 7, and it is a circular, repetitive process. In addition to that they demanded that all four layers are given same detail, as the design activities were only shown as reference.

I have applied some of the required topics and redraw the model in a different way. I placed the briefing and design activities as activities on opposite sides of the axis, where

the activities of user involvement and evaluation are in between and add towards. In this way the model better shows the interconnection between the four layers. Furthermore, I simplified the model by smoothing the layers. I still kept the important events and tools in “bubbles” in the model, but I also added a table beneath, with the proposed focus, users and methods for each phase. I also added the arrow at the end of phase 7, showing the process repeating again.

The last validation step was through a focus group workshop. The model presented to the groups, the three groups and some of their drawn suggestions in the model can be seen in Figure 46.

The groups had many different ideas how to improve the model to fit to hospital projects, but a few of the comments were common for most groups. The most common comment was that the model needs to be thicker already in phase 0, because it is here many of the activities already start and should do it with full engagement and effort, specially briefing and user involvement, but also evaluations. The groups were also demanding a simple version that they could use and transform to fit their project.

Finally, some of the discussed items from focus group workshop were implemented in the final usability briefing model, presented in Paper 5 and Figure 42 as well as Figure 47. The first phases are thicker, suggesting high efforts already from the start of the activities. The text in the model and table was updated, so that it is now including most interesting topics, but is also more accurate. I also removed the “bubbles” to simplify the model, but added texts in the background of each activity to illustrate the changing focus in the phases. The model and table are simpler to overview and read both in general terms and to find more detail information about for example a specific method for co-creation with users in phase 2.

USABILITY BRIEFING PROCESS MODEL

Usability Briefing

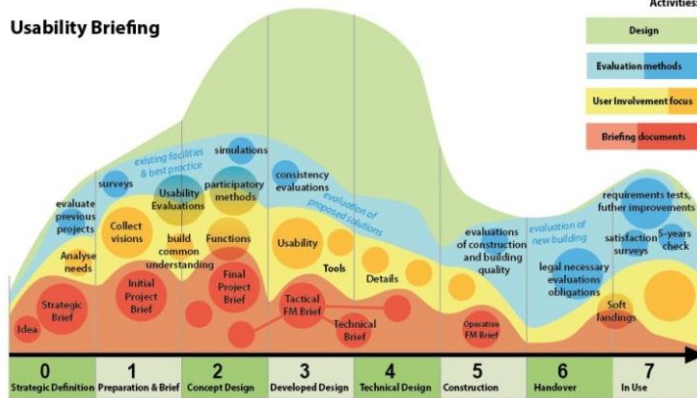


Figure 45 Aneta Fronczek-Munter presenting first version of usability briefing model at CIB Facilities Management Conference in 2014.

Usability Programming

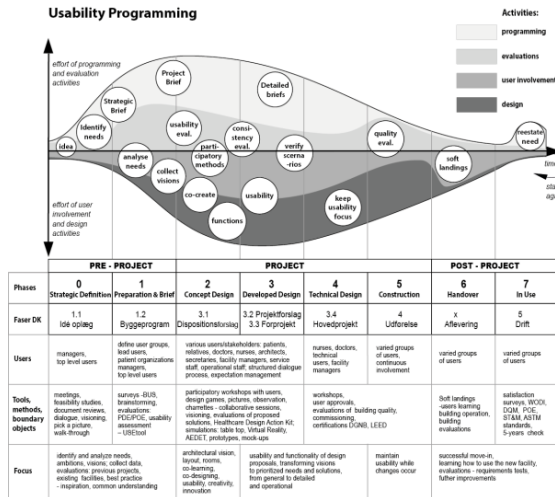


Figure 46 Usability Briefing model at the Focus group workshop, from top left- the model, Group 3, Group 1, Group 2

USABILITY BRIEFING PROCESS MODEL

Usability Briefing

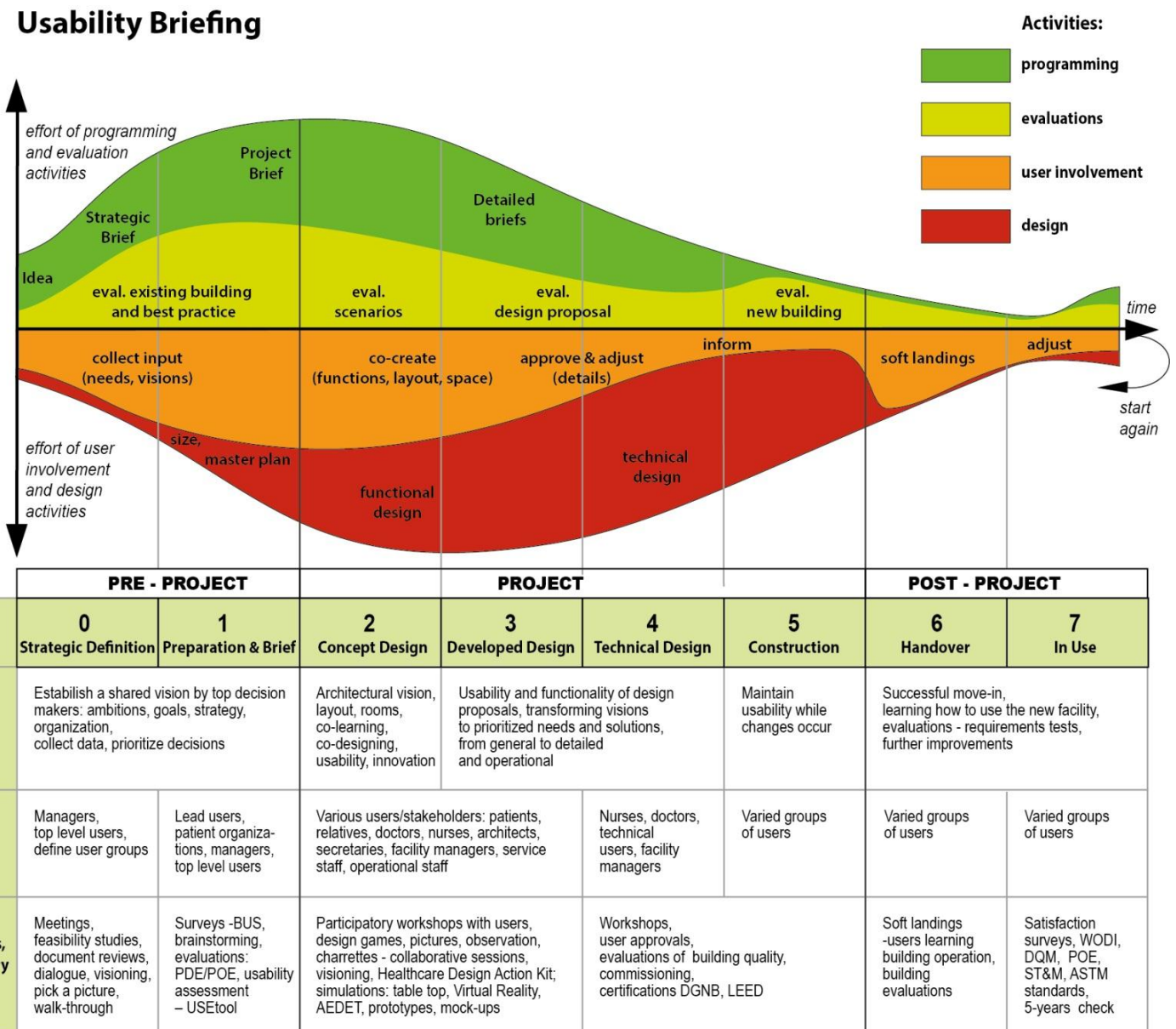


Figure 47 New Usability Briefing model by Aneta Franczek-Munter, after validation and improvements, adapted from Paper 5.

6. DISCUSSION AND CONCLUSION

This chapter summarises the findings and conclusions, followed by contributions to research and contributions to practice. Last, the limitations and agenda for future research are presented.

6.1. SUMMARY OF FINDINGS AND CONCLUSIONS

The research project started with my personal motivation to improve some of the processes in the building design sector and to contribute to buildings of higher usability, buildings which are supporting the needs of users. I was wondering why future users were not involved more in the briefing and design of the buildings and why there was , which I developed inductively on basis of a literature review of five research themes/concepts, lessons learned at the three main hospital case studies at hospitals in Denmark and Norway, exploratory expert interviews, site visits and workshops, validation expert interviews and Focus Group validation workshop.

The five research themes/concepts studied and combined in the model are:

- Usability
- User involvement and innovation
- Briefing / architectural programming
- Evaluations of buildings
- Design of hospitals

In this chapter I present how this PhD thesis and the five Papers are answering the following main research questions:

1. How can usability briefing be conducted and what should the process include?
2. How to capture user needs and experiences at healthcare facilities?

Furthermore, propositions are provided to following sub-questions:

- A. How can the briefing process be organised in hospital design/complex buildings across the building design phases to help create usable buildings? Which kind of activities should occur in different phases?
- B. What should the process of briefing focus on in different phases?
- C. Which methods can be used for effective user involvement in the different phases of the briefing and design process? Which users to involve and when?
- D. How do you choose appropriate building evaluation method for different phases or focus? What to evaluate, when and why? Ki8kk'
- E. How can the results of usability evaluations be transformed into briefing and design processes?

DISCUSSION AND CONCLUSION

The research questions were thoroughly studied and the thesis gives the following answers to them.

1. The first main research question I answer by developing my process model of Usability Briefing. In the Usability Briefing process model the research results and insights from the three hospital case studies, expert interviews and literature are combined. I propose that the Usability Briefing should be a continuous and integral part of the briefing process, combining the four interrelated activities of:

- Briefing,
- User involvement
- Evaluations
- Design

The visual model illustrates how usability briefing can be conducted as application of the four activities in all the building design phases, so they can occur at the right time and support one another. The model includes all building phases: from pre-design to handover and in use and can be applied on complex building projects. The four types of activities are shown as four layers, representing the activities and their location in the phases in relation to one another. (Paper 5)

1. Summarising, my propositions to Usability Briefing, based on research results, are to secure:

- Allowing briefing and design to interact with one another
- Involving users actively during the process, continuous user presence throughout all phases
- Changing focus in programing and design activities: from collecting data and creating visions in strategic brief, through project brief, co-learning and co-creation of functional design, to detail briefs, approvals and adjustments, securing usability of solutions and successful handover, e.g. with *Soft landings*
- Co-creation of design with users at participatory workshops
- Making evaluation an integral part of the process (evaluation of the existing building, best-practice buildings, scenarios, design proposals, new building), valuations with various users/stakeholders
- using relevant and creative boundary objects at workshops, e.g. design games, simulations

1 A, B The Usability Briefing model proposes that the briefing activities are not just happening in one phase, but should constitute a continuous process with different focus in different phases. The *strategic brief* in preliminary phases is about ambitions, size and strategy. Subsequent *project brief* focuses on architectural vision and layout, while *detailed briefs* focus on details, technical services, indoor climate, FM and operations. Furthermore, usability briefing sees briefing and design activities as not sharply divided activities, but as having intimate connection and supporting each other in frequent interactions. Moreover, the model proposes the activities of user involvement and evaluations to support activities

DISCUSSION AND CONCLUSION

of briefing and design by common learning, participatory data collection and analysis of needs. Therefore all four activities regularly support each other. (Paper 5)

1 A, B. In the Usability Briefing model, there is usability focus at all phases, also kept intact at later phases. During technical design and construction changes often occur and the proposition is that new solutions should be approved by for instance the continuous user group in order to maintain the visions and agreements from previous phases and check the usability of the new proposals. (Paper 5)

1 A, B, C, D. The Usability Briefing model also indicates focus, users and methods in each phase. The focus in early phases is proposed as collecting visions and collecting data, for example from evaluations, the phase 2 Concept Design is seen as best for co-creation with users, later phases are for detailed briefs, approvals and adjustments with users. I propose maintaining the usability focus at all times.

1, 2 C. The users and methods for their involvement are also proposed to different phases and for example include evaluating scenarios, while co-creating the layout with medical staff, patients, architects and facility managers. The tacit needs are best collected by observation and usability evaluations with users, either at own facilities or other buildings. The earlier the process, the more the involvement can be active and incorporate co-creation, at later phases it can turn to informing, adjustments and approvals. Boundary objects, as specific tools and methods for user workshops, like design games, have proven to be effective in discussing the future and starting the users in the creative mode. In general, users can be involved in various activities during briefing, evaluations and design. (Paper 3, 5)

1, 2 C. The types of users involved depend on the phase and specific aim of activity. The stakeholder analysis and definitions of user groups should occur from the very beginning of the pre-project phase. The process with user groups shall be managed, including expectations management. Furthermore, the users give input to briefing and design and are involved in evaluations. The user groups shall include various users/stakeholders and the workshops shall use relevant and creative boundary objects. The approach combines continuous and active user presence, co-creation, design and evaluation with various users. Literature research and Case 1 have shown that user-driven innovation can be nurtured by specific organisational set-ups and methods. (Paper 1, 2, 3)

2 C. The second question is also answered by adding the activities (layers in the usability briefing model) of user involvement and evaluation to the briefing and design activities in the model and the proposal of specific appropriate methods and boundary objects to both user workshops and evaluations at different building design phases. In order to explore and apply user needs to complex building projects and healthcare facilities, user involvement shall occur at the right time, according to the model, as part of a continuous process. (Paper 2, 3, 4, 5)

1 D, E. Evaluations are not just happening at the end of the building process, but also at the front-end. Moreover, evaluations give input to briefing and design and can also occur as

DISCUSSION AND CONCLUSION

participatory methods, i.e. simulations. Various existing methods for evaluations are organised in the visual “Flower model” and table overview for easy choosing appropriate method for the required focus of the evaluation, i.e. usability, beauty or technical performance. There can be various objects of evaluations: previous projects, existing facilities, best practice, proposed design solutions or new building. Usability of buildings can be evaluated with user perspective for example by making walk-through usability evaluations with USEtool, as shown in Case 3. The results give additional information about usability which can be incorporated in existing or planned buildings and their briefing documents. (Paper 2, 4, 5)

1 E. Furthermore, the architect, client and users should participate in the evaluation process personally. Otherwise it might not give much value, as much of the learning happens while discussing the surprising outcomes of observations between the different types of participants, as seen in Case 3. While doing the evaluations architects and clients collect valuable information from users that will otherwise not be available in a formal evaluation report, or as already assembled requirements. By evaluating together it is possible to collect tacit knowledge, that can be lost in the briefing process if not the same architect and client where participating in the evaluation. On the other hand some evaluation types, collecting hard facts, can be done by external parties, as in Case 2. Case 3 provided an example of evaluating scenarios through simulation, which could be valuable in project brief and co-designing layout options with architects.

Supplementary remarks

The research project focused on the process of usability briefing, but there are a few remarks to the result – the brief as well. As mentioned earlier, there are multiple briefs along the phases, with different focus and detail. Furthermore, the resulting brief documents, apart from necessary information about space needs and technical specifications etc., could also, as in as Case 2 - include narratives and openly share the dilemmas for inviting the innovative solutions.

Furthermore the boundary objects and their use in briefing and user innovation were studied. In Case 1 a set of tools, design games and simulations were tested in hospital design set up, and few i.e. Ovals design game and simulations, have proven to enable users to innovate. In Case 2 the physical 3D model of clinical structure was attached as a tool for understanding the complexity and connections of medical departments.

In this thesis I illustrate with the case studies, that if the hospital building projects apply the activities proposed in Usability Briefing process model, they can contribute to that the end results of those projects are hospitals of high usability, supporting the needs of future patients, healthcare professionals and society.

Nevertheless, I also see in the Cases, that there can be some threats and uncertainties in the Usability Briefing model. The ideal process, with all activities distributed along all phases could turn out to be very time consuming if not planned and managed carefully, as seen in Case 3. In Case 3 the results were both usable and beautiful buildings, awarded

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internationally, but also unexpected dissatisfaction by some users, who did not feel all their needs were satisfied. The solution to this problem is also shown in Case 3; at a later phase of development in Part 2, where expectations were set from the start.

The involvement of many types of stakeholders could also lead to many compromises. That risk could be minimised by separating the different groups to different interest subjects, but implementing a continuous user group as in Case 2.

Another uncertainty is whether the users are actually able to innovate in hospital projects. One view is that both medical staff and patients are so busy with what they do and experience, that they cannot imagine the future or innovate. Another view is that innovation can be awoken in both groups, under certain organisational circumstances, for example secure job situation and management supporting innovation; and with certain boundary objects helping the process, for example specific playful design games.

The lessons learned from the Cases are that intensive participatory user involvement and evaluations with users should only be done when managed properly, by not raising the wrong expectations, and done early in the briefing process. It should not just be a symbolic gesture, but a real dialogue and co-creation with users, with the outcomes seriously considered and further used in next phases of the project.

Usability is also related to *value*, which was though not part of this study. Applying the model for Usability Briefing in complex buildings, as hospitals, may add value to building clients, users and society, by improving the briefing process and resulting in better usability of buildings. Following the FM value map (Per Anker Jensen, 2010) the value impacts on surroundings can be spatial, social, economic and environmental. The added value to core business can be in satisfaction, cost, productivity, reliability, adaptation and culture. We can also strive for the use value, image value, social value and cultural value, which can be added by usable buildings.

The use of the concepts of Evidence Based Design (EBD) and Healing architecture in this PhD study was first limited, as a number of expert interviews related to it as a fancy name and marketing tool for otherwise well-known Scandinavian architecture solutions. However, it was actively used in Case 3 and partially in Case 2. Furthermore the understanding of EBD can be broadened, and not be limited to only the use of existing medical evaluations from USA and UK. My proposition of Usability Briefing model suggests that any hospital building client or hospital architect can learn from own or others' evaluations and base their design decisions on evidence. In that way this thesis can contribute to renewing the EBD discussions.

The results of this research can also be interesting to Facilities Management, seen as a strategic management discipline, dealing with people, places and processes. Usability Briefing can be applied as a tool in managing the existing hospital facilities or new complex building projects.

In general, the research results have relevance to researchers, architects, facility managers and client organisations planning new complex facilities, and especially for professionals working with briefing and designing hospitals.

Finally, I believe that it is worth focusing on usability in briefing process, because “We shape our buildings, and afterwards our buildings shape us” (Churchill, 1943).

6.2. CONTRIBUTIONS TO RESEARCH

This PhD thesis proposes a new model of Usability Briefing, developed inductively from a literature review, expert interviews and three case studies at hospitals in Denmark and Norway. The process model for Usability Briefing is combining the four activities of briefing, design, user involvement and evaluation in all building design phases. The thesis and the appended publications fill the research gaps in eleven ways, which are adding to the research communities:

1. First, the gap in the *usability research* is filled by focusing not only on *evaluation* - of products or facilities with users, after they were designed and built, but now also on *briefing process*. Therefore this PhD thesis extends the research in usability of buildings to include all phases, also before the buildings are built.
2. At the same time, the *briefing research* focusing on the processes is gaining a specific subject – *usability* and a new *process model* combining the four known activities/research themes of *briefing, user involvement, evaluations and design* and arranging them throughout all building design phases, relative to each other and additionally proposing the main focus of the phases, users and methods to be applied.
3. Third, this PhD project contributes with methods and processes for capturing user needs and experiences, in order to provide information to the design processes and thereby make sure that the result satisfies the user needs and maximizes the effectiveness of the facilities. Different approaches to user involvement, including the Scandinavian way of involving users and user driven innovation are presented in Paper 2. Specific methods of user involvement, user driven innovation and simulations with users were discussed in Paper 3.
4. The thesis also fills the gap in evaluation research by including evaluation activities already in early phases for briefing, co-learning and co-creation with users. There seems in the present research to be a lack of considerations and methods about how the results of usability evaluations of existing buildings can be transformed into briefing and design processes to improve the usability of existing and new building. This PhD project provides new knowledge and methods which increase the use value of usability evaluations.
5. Furthermore the research on evaluations is enriched with an overview and grouping of existing methods in a visual *Flower model* showing the methods according to main focus. The organising structure builds on the ancient Vitruvian three qualities of a building:

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firmitas, utilitas and venustas. Paper 4 groups the evaluation methods according to the main focus and proposes appropriate evaluation methods for different phases of hospital projects.

6. Healthcare research is provided with three long term hospital case studies from Denmark and Norway, with descriptions of processes, models and tools for user involvement, design games and simulations tested in healthcare environments. Furthermore, there is proposed a model for evaluations grouped by phases specific for healthcare.

7. Design research field is provided with testing of the known design games in a healthcare environment, where specific organisational issues can influence the co-creation and innovation. Several design research methods were tested in the healthcare field - design games, evaluations. Case 1 provides evidence that simulation can lead to innovation.

8. Furthermore, as mentioned in the previous section, Evidence Based Design research discussion can be renewed with Usability Briefing model and basing briefing and design activities on evidence captured from evaluations.

9. In a similar way the Added Value research can gain another study application, with usability briefing model and its potential for adding value to building clients, architects and society.

10 In the field of user driven innovation there can be added points of observation to the discussion, whether hospital users are actually able to innovate in hospital projects, and under which organisational circumstances. The Cases exemplified possibilities of user-driven innovation in hospital projects, but more research is needed to certainly predict the reasons of the outcomes. One view could be that innovation can be awoken under the circumstances of for example secure job situation, management supporting innovation and with certain boundary objects helping the process, for example specific design games. Furthermore, Paper 1 compares the research understandings of usability and user driven innovation and shows ways to combine the two concepts.

11. Finally, the concepts of usability and briefing are combined, with briefing not only understood as an early design phase, but as a continuous process of finding needs and requirements and developing specifications for the next phases and the final building. This PhD project develops new understanding and methods for usability briefing and how knowledge about user needs can feed into design processes. The concept of Usability Briefing/ Programming has not been thoroughly investigated before, only mentioned recently in Paper 2 with overview of user oriented research. Briefing was previously referred to as means of achieving usability (Blakstad et al., 2010; Jensen, 2010), but has been first elaborated in this way in Paper 5. The appended papers and this PhD thesis fill this gap in the research and refine the concept of Usability Briefing and present a process model for how to include Usability Briefing in complex building projects. Usability Briefing, as introduced in Paper 5, is a structured process in which stakeholders and users are actively involved in the trust-based collaboration, not only in evaluations and data

gathering, but also in a continuous briefing process with the aim to create better architectural design for supporting the users.

6.3. CONTRIBUTIONS TO PRACTICE

Similar to research, the practice can gain from the new tools and propositions from this PhD project. In this thesis and papers, I propose a new model of Usability Briefing, which is combining the activities of user involvement, briefing and evaluations, and their connections with the design processes. I suggest specific methods for hospital projects, covering the four activities and effort in all building phases. The thesis is based on learnings from three case studies at hospitals in Denmark and Norway, supported with literature review and expert interviews.

The result of the PhD research project is more knowledge about capturing user needs and the usability of the built environment from a user perspective. I developed new understanding and methods for Usability Briefing and how knowledge about user needs learnt from workshops and evaluations can feed into briefing and design processes. This knowledge can be of importance for building clients, user organisations, architects, consultants, facility managers as well as other researchers interested in complex buildings in general and hospitals in particular.

The contributions to practice are recommendations and a new set of tools for companies doing briefing/ architectural programming, architectural design, engineering, user involvement and evaluations, as well as to building clients and facilities managers of complex buildings, in particular hospitals. In other words these research results have relevance to practitioners planning new complex facilities of any kind, not only hospitals.

The healthcare client organisations, as well as architectural, briefing and engineering consultants can use my model of Usability Briefing in following ways:

- To gain an overview of the amount of activities of briefing, user involvement, evaluations and design distributed across the building phases and how they can support one another, see Figure 42 Usability Briefing process model at p.98. Usability Briefing model allows to see the big picture and to better plan own processes and manpower.
- To improve the final design, with the improved processes. The adjustments from current state are in specific activities at different phases, i.e. perform evaluations already in Phase 0 Strategic Definition, *Soft landings* in Phase 6 Handover or co-creating visions and solutions with the users in Phase 1 Preparation and Brief and Phase 2 Concept Design.
- To plan user involvement in workshops supporting briefing and design activities. Plan walk-through usability evaluations with client, architect and user groups.
- To find new market opportunities for the company; sell new processes, e.g. collecting data from evaluations or user workshops.

Furthermore, this PhD thesis provides additional practical tools and propositions of activities for the practice.

User involvement

Examples from Case studies give evidence that users can innovate, but under specific set ups conditions; see Cases 1, 2, 3. There are given examples of better design after user involvement, for example in Case 3 the spaces provide functionality and satisfaction to for both patients and staff.

There are given lists of methods, and examples of design games and workshops with user groups to support new ideas, design and user driven innovation, see Cases 1, 2, 3 and PhD thesis, section 3.2 USER INVOLVEMENT AND USER DRIVEN INNOVATION. The thesis provides practical tools, recommendations and structuring of user involvement methods and design games along the building design phases.

There is given an example of successful patient involvement, active use of Evidence Based Design, and improving the management of user groups after unsuccessful beginning, see Case 3 in Norway. There a Chief Architect was part of those processes and is very proud of the results.

As mentioned in section 6.1, the lessons learned from the Cases are that intensive participatory user involvement and evaluations with users should not just be a symbolic gesture, but a real dialogue and co-creation with users, with the outcomes seriously considered and further used in next phases of the project.

Evaluations

I provide a few tools for choosing appropriate evaluation method for a given task and building design phase. The *Flower model*, see Figure 13, p.49 and Table 5 p.50, helps choosing the evaluation methods for the buildings according to main focus and gives an overview of grouped existing methods. Additional set of evaluation methods specific for hospital is available in Figure 14 p.52.

Additionally, there are given examples from case studies of how the use of certain evaluations helped the briefing and design processes in Hospital projects, see Case 2 and 3. Furthermore, the grouping of evaluation methods can help choosing the appropriate methods and their application at the right time.

Briefing and design

As mentioned before, the Usability Briefing model proposes that the briefing activities are not just happening in one phase, but should constitute a continuous process with different focus in different phases. The *strategic brief* in preliminary phases is about ambitions, size and strategy. Subsequent *project brief* focuses on architectural vision and layout, while *detailed briefs* focus on details, technical services, indoor climate, FM and operations. Furthermore, usability briefing sees briefing and design activities as not sharply divided

activities, but as having intimate connection and supporting each other in frequent interactions. Case 2 provides an example of a soft briefing process and a requirements brief document that is openly sharing the dilemmas.

Finally, those who benefit from this thesis can use the Usability Briefing process model for overview, planning of the activities, discussions with collaborating partners and building clients. Applying the model for Usability Briefing in complex buildings, as hospitals, may add value to building clients, users and society, by improving the briefing process and resulting in better usability of buildings.

6.4. LIMITATIONS AND AGENDA FOR FUTURE RESEARCH

First limitation of this research is that the Usability Briefing process model has not been tested in practice as a whole in one hospital project over the many years of planning and building. On the other hand, the model is built by combining the learnings from three separate hospital case studies, which were observed in a few years. It is recommended to test the model in practice and refine it further in qualitative empirical research.

Furthermore, the model is not based on or applied in other parts of the world. The question is: how easily applicable or adaptable is the Scandinavian user involvement and participatory design? There are positive examples in the past of introducing foreign ideas to other parts of the world. For example Jan Gehl introduced the *Cities for people* (Gehl, 2010) and *Life Between buildings* (Gehl, 1980, 2011), in other words the Scandinavian liveable scale to the city. His ideas about the pedestrian view, activities, views and city were for example introduced and implemented with success to New York, which is known for the opposite view on city scale. Future research could implement the Usability Briefing model and its activities outside Scandinavia to validate its use in other countries and refine the generic model.

Future research could further study the model and its connection with theories and practice of Facilities Management, Added Value, and Evidence Based Design, as mentioned in section 6.1.

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8. APPENDIX

8.1. LIST OF FIGURES

If not stated otherwise, the author of all pictures and graphs is Aneta Fronczek-Munter

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8.3. LIST OF INTERVIEWS AND WORKSHOPS

A list of all 140 events, as expert interviews and workshops is attached in this chapter, grouped into cases and additional data collection; see Table 9.

A list of notes with included recorded audio from interviews and workshops are available on request. The most relevant pictures taken from the case studies are used as figures in the PhD thesis. The video recordings from HIL case are available on demand. There are a few additional sources that are only stored as handwritten notes from meetings, and are not attached.

Table 9 List of all events, as meetings, workshops and expert interviews in this PhD study, grouped to cases and companies, showing date, participating people and topic

List of 140 events: interviews, meetings, presentations and workshops

in the PhD project of Aneta Fronczek-Munter

	Legend
24	HIL, DK
27	Bispe-bjerg H. DK
5+mails	SOH, Norway
1	hospital Finland
	i2p
47	expert interviews, meetings, workshops
	relevant conference talks

APPENDIX

Session date	Recording start time	Duration	Comment to arrangement, place, topic, participants
2010			
20-08-2010			First meeting at DFM arrangement (Danish Facilities Management association) i Vedbæk Kasernen, first talks about hospitals and my research topics, possible cooperation. Executive Vice President – leading the building processes, Claes Brylle Hallqvist
14-09-2010			first HIL interdisciplinary workshop, Innovation Camp 1 - Expectations
28-09-2010			HIL meeting - paticipants planning further innovation activities
02-09-2010			Meeting at BH, research project, choosing topics and cooperation agreement. Claes Brylle Hallqvist, Executive Vice President, Lisbeth Blak-Lunddahl, PA
24-10-2010			Innovation Camp 2, workshop, Patient flow
19-11-2010			HIL experts and researchers meeting, planning further activities
25-11-2010			Observations day 1, department, Herlev Hospital
25-11-2010			Observations day 2, department, Herlev Hospital
15-12-2010			HIL user workshop - communication, patient flow
2011			
26-01-2011			HIL workshop- design games: Ovals, Squares
26-01-2011	13:07	00:10:42	HIL meeting, general discussions with partners planning of futher activities
26-01-2011	14:36	00:36:34	HIL summary discussions after observations
31-01-2011	10:04	01:05:14	Bispebjerg meeting Executive Vice President Claes Brylle Hallqvist og PA Lisbeth , describing organisation and plans with programming and user involvement
31-01-2011			Bispebjerg. Meeting and interview about programmig and user involvement - plan of the processes and status. Executive Vice President Claes Brylle Hallqvist, PA Lisbeth Blak-Lunddahl, Process chef Berit Steenstrup Damm, (now Vice President Berit Steenstrup Damm.
03-02-2011	13:13	00:34:18	Bygherreforening i2p spor3 presentation1
03-02-2011	13:48	00:10:41	Bygherreforening i2p presentation 2

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Session date	Recording start time	Duration	Comment to arrangement, place, topic, participants
03-02-2011	13:58	00:18:03	Bygherreforening i2p presentation 3
03-02-2011	14:38	00:53:39	Bygherreforening i2p presentation 4
03-02-2011	15:31	00:11:23	Bygherreforening i2p Ide til program workshop discussions further plans
24-02-2011			HIL user workshop - concept validation
17-03-2011	15:29	00:24:40	meeting i2p? Discussion with practitioners involved in planning hospitals, users, logistics, different companies representatives
17-03-2011	16:02	00:32:57	Flexibelt hospitalsbyggeri - network, workshop, meeting many parts, companies, researchers
29-03-2011	12:12	01:19:10	Bispebjerg meeting, processes, companies involved, planning, briefing
22-03-2011			HIL workshop - 3D design,presentation, discussion
31-03-2011			HIL - simulation 1 with table top simulation and users
07-04-2011	13:03	01:49:09	Bispebjerg meeting user groups 1 -audio interesant 1.14 evidens baseret design, phd alboorg og CBS 1.20, skiltning 1.30
08-04-2011			Workshop: Den gennemgående brugergruppe. Working on the vision, plan future activities about the clinical basic structure (kliniske grundstruktur) , 8., 12. and 14. april 2011.
12-04-2011	12:55	02:10:13	sustainability talks with guests and Susanne Balslev Nielsen, at a hospital
13-04-2011	12:01	00:31:54	EFMC -FM conference Vienna: users, airports, clients: planes or shopping, change in organisation, satisfaction, supplying joyfull
13-04-2011	14:11	00:21:48	EFMC -FM conference Vienna: talks user involvement: 1. Siri Blackstad, boundary objects and briefing, participatory design, users in care environment, workplace design, Reserch paper methods and tools, 2. ICT users involved
11-05-2011			HIL - simulation 2 with table top simulation and users
16-05-2011	09:02	00:09:00	Bispebjerg - before meeting the participants presentations, ofte programmering møde hver 14 dag
16-05-2011	09:13	01:38:01	Bispebjerg meeting 16 may 2011, Vagn, Claes, + Gehl, Terroir, Kuben, hospital building client and departments, kommune, briefing documents development for the competition brief, details, overskrifter, klinisk grundstruktur

APPENDIX

Session date	Recording start time	Duration	Comment to arrangement, place, topic, participants
24-05-2011	15:05	00:33:40	EFMC conference Vienna -FM in hospitals
24-05-2011	16:19	00:35:54	EFMC -FM conference Vienna: summaries from professors
25-05-2011	08:25	00:46:08	EFMC -FM conference Vienna: 12 statements FM: people, added value, building
25-05-2011	10:09	00:44:11	EFMC -FM conference Vienna: Finland, People and buildings, user, building and places, spaces, offices
25-05-2011	11:01	00:55:45	EFMC -FM conference Vienna: Keith Alexander, workplace design and use, Andersen, Suvi Blackstad
May-2011			Sightseeing at the hospital site, walk through the BH and discuss the planned activities and requirements, Site visit. Organized by Byens Netværk.
07-06-2011	10:21	01:19:34	Norway, St Olavs Hospital first site visit with Geir and interview with chief hospital architect Ragnhild Aslaksen, and university professor, evaluation and aesthetics with Birgit Cold, "healing architecture - not like the term, fashion" 00:04 "complex - users, FM, many factors", graph 0:27 : patient center, people, building, quantity, quality, space- "great challenge to change a space from being a workplace to space for healing" 0:31:23, user participation, patient organisations so important, totally changed, enormous blindness 01:04 innovation 01:09, user involvement details graph 01:12
08-06-2011	10:04	00:49:04	Bank visit with Sten Olsson, Trondheim - new architectural design, summary interview after a walk through, comparison to hospital 0:25, user involvement, different next time: 0:47 architects not much involved by construction company, the details, sign a different contract! 0:48
08-06-2011			Interview about the user involvement and user groups. 4 main subjects: results, process, documentation and pictures. Lisbeth.
09-06-2011	09:54	01:03:11	Hospital, interview with Geir K. Hansen, evaluation project of SOH, phase 1 observed for 5 years, supposed to used to improve processes in phase 2, just summed up. Summary of findings!!! And reports, building process and user processes 09:48 paper reports and pdfs
09-06-2011			Interview with Niels Olsson, user involvement in hospitals, SOH in Part 1 & 2
10-06-2011	10:18	01:33:43	interview with Geir, communication with users, boundary objects Kari, briefing "process of deeper understanding and (...)translation

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Session date	Recording start time	Duration	Comment to arrangement, place, topic, participants
			and transformation" 06:14 "translate in the right way the briefing information to design" "boundary objects - improve this understanding and translation"08:20
10-06-2011	14:06	01:39:22	interview Geir ,Use tool explained with the steps , usability, reports from Norway, Sweden, Finland, suporting tools
15-06-2011	09:05	00:50:22	HIL workshop simulation 2, discussions, summaries
15-06-2011	09:56	00:42:23	HIL, workshop, group work of HIL participants, Werner, skabelon opsamning, lessons learned
15-06-2011	10:41	00:01:43	HIL presentation round, participants
15-06-2011	10:43	00:55:24	HIL, Dims, Kasper Edwards, Ole Broberg, Werner Sperchneider, Tanja, presentation summaries from project summaries of results and workshops, simulations with boxes and patient , concepts trials, new ideas 07:11 "speed-up in innovation process"
15-06-2011	12:31	00:56:01	HIL, Patients, Regions, Werner Sperchneider, cooperations agreements
15-06-2011	13:47	01:01:42	HIL, workshop, Werner Sperschneider, Ole Broberg, Aneta Fronczek-Munter, Kasper Edwards details , DTU publicatios, methods, Aneta aticle innovation at Herlev hospital, summaries of projects A, B, C and results
16-06-2011	13:12	02:14:51	Patient Vidensforum expert workshop, Danske patienter, user involvement, consultants, userdriven innovation Odense Universitets Hospital, patient organisations, professor in psykology and patients & technology, regioner, hospitaler, book: "på patientens vejne", RUC user-patient innovation
17-06-2011	10:20	01:03:20	workshop/ expert interview about usability Keith Alexander and Aneta Fronczek-Munter, methods, users stakeholders, case results
20-06-2011	14:18	01:27:23	walk trough Triangle Hospital Finland with Suvi Nenonen, interview the host, just audio, department of oncology, patient privacy caught a bit before in the process 0:11, children hospital " rooms for visitors is luxury, more important is good care" 0:34, "children patients need rest rather than playground" 0:35, surveys, patient assosiations, not in planning groups 0:36, "should be paperless hospital, but we have papers" 0:51, colours, "it's like the cars" "you cannot listen to everybody" 0:56 involvement "it is staff" 0:57, "patients can only influence minor things" 0:57
21-06-2011	14:55	00:19:05	Suvi Nenonen - research summary buit environment, users- " real estate and construction people- we are the experts" Tekes 01:18

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Session date	Recording start time	Duration	Comment to arrangement, place, topic, participants
			"group silliness" advice to Aneta, shopping centres 0:17
21-06-2011	15:23	00:45:24	interview discussions- Healthcare well being, Denmark, Finland government decisions, Suvi and a man (name?)
21-06-2011	16:18	01:06:13	Finland- interview and discussion healthcare, Raksenmetta and Aneta, stakeholders, future workshops, changes on user orientation, traditional healthcare hospitals and clinics, the whole system from citizen point of view 02:46, "we need new methods" 03:25, mail p38, papers, contacts to people, "learn from different solutions" 01:05 researchers as well as directors and architects
22-06-2011	08:43	02:35:56	Finland -interview experts and researchers Aalto University, Suvi Nenonen, Leena, Antti Autio project manager EU project Pareto - hospital districts, special care, planning healthcare, big scale. tool, Aneta and Antti discussing process of how it can be done: "walk trough with senior people" 02:31 "the normal way - how then" "conceptual stage! give it at least half a year" 02:33 , "often hospitals contact architects too late, the budget is decided, informed expertise" 02:34 mail contact , expert info
27-06-2011	08:59	00:42:01	HIL simulations 3, introduktion, companies, participants - medical staff, innovation consultants, reserachers - discussions
27-06-2011	10:00	02:14:39	HIL simulations 3, part 1, preliminary meeting (a)and simulations (b): a-preparing for simulations, rules for the game, b- first simulations, discussions, innovation in organisation and layout
27-06-2011	14:06	03:00:09	HIL simulations 3, part 2 -gruppe A, discussions, hospitals Herlev and Hvidovre, læger, gynecologic ambulatoriums, patient safety, doctors, ie. Morten Lebech, companies: Grontmij, researchers: DTU , simulations
29-06-2011	13:04	00:55:08	DTU expert researchers meeting about user involvement in hospitals - discussions, compare experiences, prepare international seminars, also HIL research summarised 0:43, patients not possible to invite to HIL 0:50, 2 patients interviews 0:50:43 objects - every time changed then new ideas 0:51 scenario driven simulations 0:53
29-06-2011	14:03	00:53:19	DTU experts meeting - participants,
29-06-2011	14:56	01:22:15	DTU experts meeting - efter Design Lab, textiles, DNV, idea catalogue a good patient room, a good waiting room, evidence - discussion,
07-07-2011	13:02	02:03:21	HIL, summary meeting reserach and companies participants,

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Session date	Recording start time	Duration	Comment to arrangement, place, topic, participants
			discussions, most important reflections
08-07-2011	10:08	01:20:17	Bispebjerg 2 meetings: 1.Lisbeth 10-11.30 HIB grupper, important reasons user involvement 0:11, process 0:34 analysis Lohfert&Lohfert, results, articles
01-08-2011	14:51	00:39:12	Bispebjerg hospital - Vagn interview, briefing process and HIB grupper
01-08-2011			Interview about the briefing process. Vagn, Brief chef.
04-08-2011	14:15	01:29:36	expert interview at Lohfert &Lohfert - with Carolina Lohfert Praetorius +1(and Henrik Praetorius?), Lyngby- Discussion experiences -my research project, their offices in Denmark - Lyngby, in Germany Hamburg, user involvement, hospital planning
16-08-2011			Meeting with Pernille Weiss Terkildsen, Archimed.
2012			
20-02-2012	15:26	00:46:15	interview & discussion with Juriaan van Meel, update on practice in hospital projects, Hillerød Hospital - design brief to architecture competition, Client organisation, different and radical approaches,ways to do briefing, wishes, expectations, cases
20-02-2012	16:21	00:28:23	expert interview - Juriaan van Meel, ICOP, explaining and trying a briefing tool - Brief builder
02-03-2012	13:51	01:00:47	interview Terroir, Camilla, their role in briefing to Bispebjerg hospital, focus points, design research, architectonic issues, city
02-03-2012			Interview: Briefing. Camilla Jensen Thorup, Terroir.
07-03-2012	10:23	01:15:33	interview Pernille Weiss Terkildsen,company ArchiMed -architect, politician, reseracher, nurse, company director, Phd byggeprojekter bygherrer evidensbaseret design, her company did facilitation of user groups HIB at Bispebjerg, dilemmas
07-03-2012			Interview: User involvement, interview about workshops with users, facilitation, and hospital planning and design. Pernille Weiss.
22-05-2012	09:53	01:18:14	interview Gehl architects, their work practice, experiences in Bispebjerg Hospital case, user data
22-05-2012			Interview: Briefing. Solvejg reigstad and Helle Lis Søjholt, Gehl architects.

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Session date	Recording start time	Duration	Comment to arrangement, place, topic, participants
05-06-2012	13:45	01:01:29	interview Claes Brylle Hallqvist - Executive Vice President, summaries and look back at the hospital process, priorities, questions from interview guide
05-06-2012			Interview: User involvement and briefing. Claes Brylle Hallqvist, vice director.
Sep-2012			Site visit, discussions: Guests from ZHAW in Zürich, (Zürcher Hochschule for Angewandte Wissenschaften)
13-09-2012	14:08	01:20:52	feedback and discussion - Aneta F-M & Bispebjerg Hospital - many participants: Claes and client building organisation, briefing and user involvement, results, lead user, timing, workshops, Balance scorecard
13-09-2012			Feedback meeting at Bispebjerg office. Many participants, Claes, Stine Kyung Pitney, Region Hovedstaden.
14-09-2012	09:08	00:34:06	environmental aesthetics course at NTNU - theories, student presentations, experts -lay people
14-09-2012	09:50	01:49:08	lecture NTNU by Ragnhild Aslaksen,: environmental aesthetics, "use theory to be better architects" in practice 01:26, "include the patient in architecture", St Olavs Hospital - experience, hospital structure in Denmark and Iceland, also hospital user-patient
14-09-2012	11:41	00:03:51	interview and discussions with students and Ragnhild Aslaksen, NTNU, CF Møller focus group, dynamics in space, atmosphere comes instantly 01:10, "start with the atmosphere" at 01:38, it is so complex" 01:46, give birth room, what most important?! calm 02:22 "space, atmosphere"-but is "nobodys task at the moment" 03:34
14-09-2012	12:53	00:11:56	interview with Ragnhild Aslaksen, chief hospital architect at SOH, interviewed at NTNU, processes, user involvement at hospitals, the organisation and architects facilitating workshops, discussions, hierarchy issues 02:34, patient involvement good experiences - single bedrooms, privacy, typical problems
28-09-2012	09:00	00:48:16	lecture NTNU: environmental aesthetics , place to appreciate, architectural students examples
28-09-2012	09:57	01:18:44	lecture NTNU: environmental aesthetics and psychology and environment, how you perceive architectural environment, preferences, discussions with Birgit Cold and Ragnhild Aslaksen
02-11-2012	10:38	01:22:50	lecture NTNU Birgit Cold, place studies at NTNU Trondheim, Norway, architecture and place evaluation, theories and methods,

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Session date	Recording start time	Duration	Comment to arrangement, place, topic, participants
			quality ,place studies Jan Gehl -0:40- necessary activities,optional, follow up activities - great space quality, semantic differential 0:42, future hospital 1:15 way showing, St Olavs hospital examples
07-11-2012	09:15	01:09:20	Expert meeting at Copenhagen Business School -Superhospitals and project management, presentaions, discussion
17-12-2012	11:25	01:22:44	interview company FORCE, discussions, 4 people, Thomas Koester, Charlotte Hjort, Betina Rangstrup, psychology department and healthcare projects, cooperation with DTU Management Engineering, Dansk Human Factors Center, healthcare and other technological fields, design of ships, hospitals, safety, user friendly, space and environment
17-12-2012	13:34	00:24:05	summary, future possibilities, projekt , videnkupon
2013			
08-01-2013	10:44	01:53:40	interview and discussion with Arkitema, person? layout, patient paths, learn from other projects, current hospital projects, phases, orientation, transparency, ambulatory, Evidence Based Design 0:22 "nordic architecture - no problems because fx daylight access always in focus because it is so dark" arkitecs working method and learning base - "of course there should be a view out, etc..." scandinavian way -" we have always done that, but now it has become brand ", 5. sense making method, briefing - Gødstrup , konkurrenceprogram but not byggeprogram, på rum niveau, analyses, user workshops, klynger og programmering
24-01-2013	16:36	00:43:56	Claes Brylle Hallqvist Bispebjerg Hospital, presentation DFM, the project - building, healing architecture, Facilities Management CAFM, challenges
04-02-2013	13:34	00:52:24	project management 1/5, Christian Tuesen, professor, lecture for PhD students, collaborative, involve, ressources, communicate, goals and methods, purpose, business case priince 2
04-02-2013	14:35	00:25:45	project management 2, stakeholder analysis and management, project planning, milestone planning, risk management, failiures
04-02-2013	15:10	00:00:22	project management 3, pause
04-02-2013	15:19	00:25:25	project management 4, group work, stakeholders, extedning the network
04-02-2013	15:45	00:03:43	project management 5, chaotic world, stakeholders, power types

APPENDIX

Session date	Recording start time	Duration	Comment to arrangement, place, topic, participants
07-02-2013	10:48	01:47:26	meeting phd discussion with Werner Sperschneider, POE- panel of experts , not only Post Occupancy Evaluation, PDE - pre design evalation! Companies examples for future cooperation cases, healthcare, hospitals, briefing, architecture, future article
18-03-2013	15:35	00:52:16	interview and discussion with Werner Sperschneider - innovation consultant, Ph.D., HIL simulation, innovation, all 3 project parts - long "time waiting for innovation - get ownership of the parts" 01:50
18-03-2013	16:32	00:40:31	interview and discussion with Werner Sperschneider - innovation consultant, Ph.D., HIL simulation, who are users 0:13
09-04-2013	15:33	01:09:35	Andrea Kahn , lecture , NY, Future urban sustainable environment, data/design discussion
22-05-2013	11:23	00:08:19	Euro FM conference, landscape of FM reserach, Suvi Nenonen, Theo van der Voordt, Peter Preischl - "challenge fairytailes" 06:50
22-05-2013	12:31	00:30:37	conference, post graduate research workshop, Aneta paper presentation - evaluation methods and hospital projects 03:36 and QA comments
23-05-2013	13:30	01:02:00	few conference presentations: Suvi Nenonen "6D model" capture user experience, workplaces, usability, places and spaces, "experience is felt at the moment", this term rather than satisfaction, 1.atmosphere, 2.frequences, 3.functionality, 4.familiarity, 5.narrative, 6.importance, another presentation mathematical simulation
23-05-2013	16:35	00:43:32	interview with hospital Susanna Caravatti-Felchlin, Facility Management Project Leader USZ new building at UniversityHospital Zurich, interested in Anetas "flower model", hospital requirements, Susanna is interested in new buidings and radical innovation. Aneta - models at strategic level, what are the expected results?, interest " how much and whom do I involve from the industry?" 35:44 objective solutions, requirements, flexibility
11-06-2013	08:36	01:01:19	meeting at CFM Centre for Facilities Management, DTU with Kathy Roopert, Georgia Tech and Michael Pitt, UCL, UK, ch. Surveyor, FM, publishing, hospitals, founding and editor of "Facilities", Integrated Project Delivery -Kathy suggests
11-06-2013	09:40	00:40:05	talk with Michael Pitt -example Barts Hospital, biggest in London, working for both the trust and the consortium, the users- "the flight passengers are not the users, there has to be somebody to

APPENDIX

Session date	Recording start time	Duration	Comment to arrangement, place, topic, participants
			fly the plane" 04:12, stakeholders and patients
17-06-2013	12:33	01:27:32	DTU researchers presentations and discussions on hospitals - healthcare - design science, all participants present themselves, DTU, Patrick - presents simulation, tacit knowledge 0:23:08 participation technique, Peter Hasle professor -lean in healthcare, value systems, " patient is the customer " 0:39:27 , "nurses got angry -how could you question that they see patient at the core" 0:39:42, value systems, complex vs complicated - 0:36, "get useful patient input -difficult" 1:14:21 Aneta presents own case results 1:14:26, LEAN projects
17-06-2013	14:13	00:25:20	talk by Jørgen Winkel on Value Stream Mapping at hospital units, three nordic countries, Ergo VSM, participatory tool, study design, 14 wards, hypothesis: focus on performance - positive effect, Per Langaa DTU, innovation management
19-06-2013	13:51	00:40:02	meeting Werner Sperschneider- part 1 - innovation results from users, discussions on cases, experiences Aneta and Werner, 0:28 patients involvemnet no results, why?- "they were not involved just used as test person"
19-06-2013	14:33	00:29:34	meeting part 2 - focus on users, cases
20-06-2013	11:42	00:27:22	conference at Dansk Industri - Danish Regions, about New superhospitals, 16 new hospital building projects, 7 totally new locations, 9 modernisations, examples, differences, expert presentations, discussions
20-06-2013	12:10	01:06:38	Gødstrup hospital, 130.000 m2, pejlemærke, sporbahed
20-06-2013	13:55	00:28:03	conference at Dansk Industri - Danish Regions, about New superhospitals. Syddansk Universitetshospital - conference presentation, Diana Arsovic - Syddansk Sundhedsinnovation- needs, experts, user innovation /involvement methods 07:23, hospital OUH , Odense
20-06-2013	14:23	00:22:21	Grundfoss - conference presentation, technology , hospital and water cycle, Herlev hospital
20-06-2013	14:46	00:06:28	conference presentation, hospital projects
20-06-2013	14:53	00:17:33	conference Presentation . Hospital technologies, robots
21-06-2013	10:24	01:04:54	interview with Mikkel A Thomassen - Smithinnovation -i2p ?-Smith Innovation?, projects Ny Hospital Nordsjælland i2p -, vision & user involvement for Hvidovre, Juriaan and Mikkel, information strategy, briefing/programming til NHN case, user types 0:49,

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Session date	Recording start time	Duration	Comment to arrangement, place, topic, participants
			early phases, methods
24-06-2013	12:59	01:18:01	interview Schmidt Hammer Lassen with Kasper Heiberg Frandsen, ass. Partner, different hospitals, good briefs, brutto/netto byggeprogram fase with users, Kolding, user groups- Aarhus arkitekter, CFMøller
01-07-2013	13:10	01:55:12	interview Poul Henrik Due, COWI, Grontmij, Poul Henrik Due, Chief Advisor, planning & design, Facilities Management, discussion hospitals, users, evaluations, briefing, examples hospitals, technical operations, logistics, commissioning - requirements and tests, continuous brief,
11-09-2013	09:37	00:46:21	Lise Silberling - focus on somatic hospital, user involvement, simulation method, other methods, mock-ups full scale - advantage"physical element you can touch, not just theoretical" 23:28 like drawing, "how many people can be in this room, is it easy with wheelchair?"
11-09-2013	10:29	00:21:51	Dorthe Kjerkegaard - focus on psykiatri - their project, history, region Syddanmark, involved: patients, nurses, cleaning, companies. advice to other hospital projects: "The only way to involve patients is to be excessive enthusiastic (Overdrevet entusiastisk), call them again and again" 20:52 "and tell to the management -it takes time"
11-09-2013	11:05	00:16:52	other projects, research, prototypes, motivation, idea generation
11-09-2013	11:24	00:11:11	Carina Johannessen - games and scale models to simulation, Living LAB, hospitaler, workshops, mock-ups, Aneta and Simone, video of their mock-up projects OUH innovation,
17-09-2013	12:34	00:52:00	1. Juriaan van Meel - phd Anetas usability model- comprehensive, holistic,integrated, updated briefing, discussing reserach/consultancy, 2. interview Juriaan van Meel - briefing experiences in danish hospitals, special needs from architects, client, user, which information important to brief? - brief also communication back to staff by client "means of communication" 0:43 "if you talk about innovation- it is to have a client that is pushing you" 50:20
20-09-2013	15:35	00:41:11	Behind the scenes Rambøll - the good briefing process (i2p) users, dialogue, Witraz -architects, 1 Jan Lindboe (Rambøll), Tine Restler antropolog, project - culture house for youth and library in Copenhagen Nordvest - competition brief - a good example, success story, users involved

APPENDIX

Session date	Recording start time	Duration	Comment to arrangement, place, topic, participants
20-09-2013	16:23	00:21:58	Behind the scenes Rambøll - light and landscape, project and cooperation between different professionals
20-09-2013	16:52	00:24:44	Behind the scenes Rambøll - i2p, presentations, summary and discussion - a good process, different participants -Per Zwinge , chef Witraz architect office (now part of Rambøll), briefing, respect, dialogue with users , Mari Brandl - Rambøll
30-09-2013	09:08	00:27:13	Performance indicators in healthcare - DTU conference, Jan Mainz - professor, MD, Ph.D. medical director, Region Nordjylland, psykiatry, Danish Healthcare - achievements, quality measurements, unique transparency, patient identifier, quality of care "quality is never an accident" - John Ruskin 1819-1900 slide citation, 24:30
30-09-2013	10:45	00:39:14	Performance indicators in healthcare - DTU conference, professor Mary Dixon Woods - University Leicester - presentation: quality of care in hospitals, examples mostly from UK, historical sketch on patient safety in hospitals, research results - ie study 2012 "around 5% of deaths at hospitals in England are preventable" 09:36, targets and terror 35:27 -illusion of control
30-09-2013	11:25	00:09:01	Performance indicators in healthcare - DTU conference, professor Mary Dixon Woods -questions and discussion, patient safety and quality indicator, creating value for patients, translation process
10-10-2013	11:16	00:07:06	presentation by Aart architects- Anders Tyrrestrup at Building green conference -sustainability, AART+ integrated design process, architecture projects based Vitruvian qualities "architecture consists of three parts - the beautiful, the functional, the durable" 06:16 , "sustainability in social, economy, environment" 06:07
21-10-2013	19:02	00:15:14	interview with 2 medical doctors from Hillerød and Glostrup hospitals, Merete Hetland, chief physician in rheumatic diseases, Stian Wærsted, MD. about design of hospitals, how space and rooms is usable for them, positive and negative important parameters, user involvement experiences, patients and doctors, functionality, aesthetics - not clinical
25-11-2013			interview with MD Jenna Steffansdottir, design of hospitals, user involvement, spaces to support your work and well being of patients
13-12-2013	13:51	01:20:52	interview Aart Architects - participants, design program, functional requirements, the hospital projects: DNU Skejby, DNV Gødstrup, placement in Sanders model - which kind of user involvement

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Session date	Recording start time	Duration	Comment to arrangement, place, topic, participants
			1:16:45
13-12-2013	15:44	02:15:21	interview Aarhus Arkitekter - hospital projects - Rigshospital, Aalborg, Silkeborg , area standards, brutto/netto, user involvement, user groups, how to capture tacit/recognised user needs? "by provoking them, often you need to make a narrative universe for them!" 1:44:00 how to involve patients? "narrative- they should not consider themselves too much - not about sickness" 1:44:56 usability, 1:40 - my usability model use in praxis, 1:43 the 10 questiones answered
2015			
20-10-2015	13:54	03:41:22	Focus group- usability model validation workshop, participants from hospitals client groups, managers in architecture and engineering companies designing and briefing for hospitals, group work and discussions, comments from practitioners, building process, user involvement, 3 groups, group 1 summary Naja Lynge - 2:31:28 , group 2 summary Werner Sperschneider - 02:41:01 dolphin model or whale model, involvement vs influence, group 3- 02:53:30 shark model, benchmarks

8.4. INTERVIEW GUIDES

Typical interview questions are shown in two following examples

MØDE OM BISPEBJERG HOSPITAL : PROGRAMMERING TIL HELHEDSPLANKONKURRENCEN OG BRUGERINVOLVERING

Bispebjerg Projektet

Bispebjerg og Frederiksberg Hospitaler
Bispebjerg Bakke 23, indgang 20B
2400 København NV, Tlf: 35 31 35 31

5. juni 2012 kl. 14.00

Mødedeltagere

Claes Brylle Hallqvist, Vicedirektør, cand. ing. et jur.
Aneta Fronczek-Munter, PhD Student, Architect M.Sc.

Mit PhD projekt handler om programmering og design af brugbare hospitaler. Keywords: Usability Briefing, Brugerinvolvering, Innovation, Facilities Management, Evaluering af bygninger i brug. Jeg deltog i nogle af jeres programmeringsmøder og brugerworkshops som observatør - "flue på væggen". Tak for muligheden!

FORBEREDELSE

1. Hvad var visionen? (før) ideoplægget? Hvad har I startet med, og hvordan så I fremtidige processer? Er der noget, som gik anderledes end planlagt?
2. Hvornår blev der truffet beslutning om at have mange involverede parter til at indsamle viden? Hvor finder man de bedste?
3. Post Occupancy Evaluation, evaluating usability på hospitaler? Hvordan bruger man faciliteter? (ture i egne bygninger og andres, hvad virker godt?)

KONKURRENCEPROGRAM

Evaluering af processen, - beskriv.

4. Hvilke beslutninger var taget på forhånd i bygherre projekt teamet? Opstart workshops?
5. Hvor meget var blevet besluttet om proces plan? – (tidligere har Aneta vist forskellige modeller og spurgt Vagn om jeres svar: "Normal proces") og alligevel utraditionel programmering proces/dokument?
6. Hvordan var samarbejdet med de andre deltagere (Bispebjerg projekt team og HIB brugergrupper, Terroir, Kuben Management). Hvem lavede hvad? Skete der nogle ændringer i forløbet? Hvis ja, hvorfor?
7. Prioritering – hvordan, hvad var vigtigst? (Dilemmaer i programmet – brugt som kommunikationsmiddel?)

Evaluering af resultatet : Masterplan konkurrence program,

8. Hvad lykkedes? Hvad er (var?) anderledes?
9. Citater fra brugere – kun ord eller vigtig forståelseselement?

BRUGERINVOLVERING

10. Hvordan og hvem har planlagt workshops?
11. Hvad er vigtigst, når man planlægger og udfører workshops med brugere?
12. Beskriv resultater. Hvad lykkedes? Var der nogle overraskelser?
13. Hvad var den mest vigtig grund til brugerinvolvering? Prioritering, vælg de vigtigste. Var der også andre grunde?
 - få klinikerens visioner/ideer
 - få inkorporeret brugerens viden i programmet
 - få bekræftet vores ideer/visioner, quality assurance
 - samle organisationen Bispebjerg+Frederiksberg+Psykiatrisk – sammenhold
 - politisk korrekthed – man skal involvere
 - skabe medejerskab og goodwill
 - beslutninger
14. Hvem er bruger i brugerinvolvering / brugerdreven innovation på hospitaler? Hvem udvalgte deltagertyper til HIB?
15. Brugergruppen med unge generationer/ fremtidige patienter og ansatte – blev det til noget? Hvis ja, med hvilket resultat?
16. Fortæl om samarbejdet mellem deltagere. Hvem var med og i hvilke roller, i planlægning og udførelse?
17. Andre typer brugere (nabolaget, presse, patienter) – blev de informeret/inddraget på anden vis?

PARALLELE PROCESSER:

a) Brugerinddragelse i HIB grupper og programmering til konkurrencen.

18. Hvor var forbindelsen mellem de 2 processer (brugere+program)? Hvordan har de processer påvirket hinanden?
19. Hvordan har I sikret gensidig udveksling af ideer, viden og status på beslutninger?
20. Hvor i programmet kan man se tegn på brugerens ideer? (citater fra workshops i HIB grupper? Molekylemodel – hvordan er det vist? Andet?)
21. HIB katalog – hvem kan/vil bruge det nu?

b) Mange studier og rapporter før programmering og involvering.

22. Hvad var indholdet? Hvordan kunne I bruge dem? Hvem brugte dem ellers og til hvad?
 - Drees & Sommer, (nu er de også ét af 2 vinder forslag! Måske fordi de har gravet dyb i Bispebjerg H. før?)
 - Lohfert & Lohfert
 - Terroir - Designforskning
 - HIB brugergrupper rapport og løbende ideer
 - Tælling af brugte og ikke brugte rum overalt på hospitalet
 - Rum standarder – hvilke?
 - Flere?

ØVRIGE

23. I har for nyligt ansat 2 personer til brugerinvolvering. Hvad er jeres næste planer? Hvad skal de arbejde med hos jer?
24. Nytænkning i processer på hospitalet, fx logistik – møde med Skåne i sidste uge. Hvad kan man gøre anderledes? Inspirationsture?
25. Hvad er I stolte over? Ville du lave noget anderledes næste gang? Hvilke anbefalinger kan du give til andre med brugerinvolverings- og programmeringsprocesser?

MØDE OM DESIGN AF HOSPITALER OG BRUGERINVOLVERING :

8. januar 2013 kl. 10.00

Arkitema

Rued Langgaards Vej 8, 2300 Kbh S

Mødedeltagere

Jesper Bo Jensen, Arkitekt MAA, jbj@arkitema.dk

Aneta Fronczek-Munter, PhD Student, Arkitekt M.Sc., afmu@dtu.dk

Mit PhD projekt handler om programmering og design af brugbare hospitaler.

Keywords: Usability Briefing, Brugerinvolvering, Innovation, Facilities Management, Evaluering af bygninger i brug.

DESIGN AF HOSPITALER

1. Hvordan arbejder I med hospitalsprojekter?
2. Eksempler: DNV-Gødstrup (Region Midtjylland, Herning), 129.700 m2 samlede areal, fortæl om dette / vis projektet...
3. Hvordan sikrer I innovation?
4. Hvordan bruger I konceptet Helende arkitektur / Evidensbaseret design (EDB) ?

BRUGERINVOLVERING - ARKITEMA SENSMaking METODE

5. Beskriv processen. Hvor meget bruger I den?
6. Hvad er vigtigst, når man planlægger og udfører workshops med brugere?
7. Hvordan afdækker I de ikke erkendte behov hos brugere?
8. Hvornår skal man involvere hvilke brugere og til hvad på hospitaler?
9. Brugerinvolvering som kerneområde i Arkitema? Business – som tilkøb eller integreret del af byggeprojekter?

INTEGRERET PROGRAMMERINGS OG DESIGN PROCES

Mikadohuset 2006, projekt med Realdania m.fl.:

10. Hvordan ser processen ud?
11. Kan disse processer bruges på hospitaler?
12. Arbejder I ofte på programmeringsopgaver? (Metro, flere?..) Hvad er vigtigst i denne type arbejde?

EVALUERINGER

13. Laver I evalueringer af hospitalsbygninger, som er taget i brug? POE, etc.
14. Har I prøvet at være på studieture/evalueringer sammen med brugere? Co-learning, inspiration...

PHD PROJEKTER HOS ARKITEMA:

hvad er bidrag til Arkitema?

2 PhD studerende med brugeren i centrum, begge bidrog til konkurrence OUH (Odense Universitets-Hospital):

- Jeanet Lemche – fremtidens hospitalsarkitektur, byggede omgivelser påvirker helbred, patientens oplevelser til at bruge i designprocesser, 4 processer om fremtidens sundhedsbygninger
- Lene Lottrup – landskab, naturoplevelser mod stress, sundhed, velvære

PILOTPROJEKT MED ANETA + HOSPITAL + FORCE TECHNOLOGY + ARKITEMA?

En mulighed for et projekt med *udvidet videnkupon*, at lave pilotprojekt sammen, hvor alle kan anvende erfaringerne i deres videre forløb

- Aneta bidrager med ideer til afprøvning, faciliteringsmetoder, forskningsforankring og arkitektbaggrund, vil publicere resultater
- FORCE Technology bidrager med psykologbaggrund og viden om brugere, har erfaring i ansøgninger
- Hospital X- bidrager med case: nybyg eller ombygning, og brugere – patienter og klinisk personale til nogle workshops
- Erfarne arkitekter inden for hospitalssektoren med fokus på opstartsprocessen, deres forståelse og involvering af brugere, - Arkitema?

VIDERE PHD FOKUS FOR ANETA

Hvad ville være mest interessant for jer at vide mere om?

1. Flere hospital cases – observation af eksisterende processer i programmering, brugerinvolvering, design
2. Programmeringsprocessen - udvikling
3. Brugerinvolvering – udvikling af effektive metoder, som fremmer innovation, behov afdækning, facilitering
4. Evalueringsmetoder – vælg og tilpasning af metoder til brug i hospitalsprojekter, sammen med brugere, både til at lære fra egne succeser og fejl og inspireres af de bedste

8.5. LIST OF ALL SCIENTIFIC AND POPULAR PUBLICATIONS

PAPER 1

Fronczek-Munter, A. (2012). Usability and user driven innovation - unity or clash?. In *Proceedings*, Presented at: 13th International FM&REM Congress, 2011, Kufstein, Austria.

PAPER 2

Jensen, P. A., Alexander, K., & Fronczek-Munter, A. (2011). Towards an agenda for user oriented research in the built environment. In 6. Nordic Conference on Construction Economics and Organisation: Shaping the Construction/Society Nexus. (Vol. Executive Summaries - full paper in electronic proceedings (ISBN: 978-87-563-1514-2), pp. 55-56). Hørsholm: Danish Building Research Institute, Aalborg University.

PAPER 3

Fronczek-Munter, A. (2012). Facilitating User Driven Innovation – A Study of Methods and Tools at Herlev Hospital. In *Proceedings*. Facilities management research in the Nordic countries (ISBN: 978-87-50210337), pages: 199-214, 2012, Polyteknisk Boghandel og Forlag, Kgs. Lyngby. Presented at: CFM Nordic Conference, 2011, Kgs. Lyngby

PAPER 4

Fronczek-Munter, A. (2013). Evaluation methods for hospital facilities. *International Journal of Facilities Management*, (Special issue), (ISSN: 1365-702X), pp.215-226. Presented at: 12th EuroFM Research Symposium, 2013, Prague

PAPER 5

Fronczek-Munter, A. (2016). Usability Briefing – a conceptual process model based on hospital projects. *CoDesign, International Journal of CoCreation in Design and the Arts*, original paper submitted 24.03.2016

PAPER A

Fronczek-Munter, A. (2014). Usability Briefing - a process model for healthcare facilities. In P. A. Jensen (Ed.), *Proceedings of CIB Facilities Management Conference 2014*. (pp. 266-279). Polyteknisk Boghandel og Forlag. Presented at: CIB Facilities Management Conference 2014, 2014, Copenhagen,

PAPER B

Fronczek-Munter, A. (2013). Brugerinvolvering og programmering for masterplan konkurrence på Bispebjerg Hospital. In K. Nielsen, P. A. Jensen, & E. Kartholm (Eds.), *CFM artikler 2009-2013 - Sænummer af FM Update*. (pp. 101-106). (ISBN: 978-87-996264-0-3) Dansk Facilities Management Netværk. (FM Update).

Papers A and B are not included in APPENDIX to this PhD thesis

9. APPENDED PAPERS

This chapter includes the five APPENDED PAPERS in full text.

9.1. PAPER 1

Fronczek-Munter, A. (2012). Usability and user driven innovation - unity or clash?. In *Proceedings*, Presented at: 13th International FM&REM Congress, 2011, Kufstein, Austria.

USABILITY AND USER DRIVEN INNOVATION – UNITY OR CLASH?

Author:

PhD student, Architect M.Sc. Arch. Eng. *Aneta Fronczek-Munter*
Technical University of Denmark, Department of Management Engineering,
Planning and Management of the Built Environment

CV

The author is an Architect Engineer, M.Sc. with 6 years of experience in the architecture and planning industry, mainly in Denmark, Poland and Germany. She was involved in several projects of various scale in commercial architecture, including both master planning and interior design. She is currently working with research in Usability, Briefing, Facilities Management and User involvement in Hospital buildings as a PhD student at Technical University of Denmark.

ABSTRACT

Aim: To present different understandings of the concepts ‘usability’ and ‘user driven innovation’ and discuss if and how the built environment can benefit from these concepts and the unity of them.

Approach and methodology: The paper is based on literature reviews of scientific journals and other influential publications within the academic fields of Facilities Management, Architecture and Engineering, Participatory Design and Software design.

Outline: The paper will discuss different understandings of the concept ‘usability’ and its relation to ‘user driven innovation’, which depends on the academic field and area of professional application. The concept of usability has its roots in evaluations of consumer products and user interfaces of computer software. During the last 5-10 years there has been a new development of research in usability of buildings and workplaces. Recently researchers have identified additional key concepts to usability: Context, culture, situation and experience. Understanding those might be achieved by involving users. In this paper, usability of the built environment will be related to the idea of ‘user driven innovation’ - participatory processes in which users are involved in design. The question in this paper is *to what extent*, and *how* users can be involved in design processes to create better and innovative buildings of enhanced usability.

Keywords: usability, user driven innovation, built environment, facilities management, participatory design

INTRODUCTION / OBJECTIVE

There seems to be a lack of common understanding of the concepts ‘usability’ and ‘user driven innovation’ across different professional fields. This paper aims at presenting the different understandings of the concepts ‘usability’ and ‘user driven innovation’ and discussing if and how the built environment can benefit from these concepts and the unity of them.

The concept of usability has its roots in evaluations of consumer products and user interfaces of computer software. During the last 5-10 years there has been a new development of research in usability of buildings and workplaces. Recently researchers have identified additional key concepts to usability: Context, culture, situation and experience. Understanding those might be achieved by involving users. In this paper, usability of the built environment will be related to the idea of ‘user driven innovation’ - participatory processes in which users are involved in design. The question in this paper is *to what extent*, and *how* users can be involved in design processes to create better and innovative buildings of enhanced usability.

The claim is that the two concepts supplement each other and user driven innovation can be used as one of the methods to improve the usability of the built environment. The field might benefit from a deeper understanding of the concepts and learn from experiences from other fields.

Those who benefit from this paper can include Facility Managers and building clients in general, as well as actors involved in planning the facilities, like architects, engineers and designers.

DESIGN / METHODOLOGY / APPROACH

The paper is based on literature reviews of scientific journals and other influential publications on subjects *Usability* and *User driven innovation* within the academic fields of Facilities Management, Architecture and Engineering, Participatory Design and Software design.

The paper analyses the literature and discusses the different understandings of the concepts *Usability* and *User driven innovation*, depending on the specific field. The result of the analysis and one of the goals is broadening the awareness of possible positive impacts of combining the understandings and experiences with *Usability* and *User driven innovation* from several professional fields. The paper shows the advantages of the *Usability* and *User Driven Innovation* concepts to the field of Built Environment, where they have not been used widely yet. The implications for practice are therefore mostly gaining more understanding of positive values of using the concepts of *Usability* and *User Driven Innovation* in this context. Such a deeper understanding of the concepts can be gained by combining existing knowledge from different professional fields in new ways.

It needs to be mentioned that the author has own experiences as an architect in planning built environments. Those experiences undoubtedly influence the focus and approach of the research and this article. Furthermore she is involved in case studies in healthcare sector, and the initial stages of planning healthcare facilities, where the concepts of *Usability* and *User driven innovation* are tested with the plan of future additional publications of the results.

RESULTS OF LITERATURE REVIEW

CONCEPT OF 'USABILITY'

The concept of *Usability* is defined in ISO 9241-11 as: "The extent to which a product can be used by specified users to achieve specified goals with effectiveness, efficiency and satisfaction in a specified context of use" (ISO, 1998).

The concept of *Usability* has its roots in evaluations of consumer products and user interfaces of computer software. It is though widely understood nowadays as *Usability Tests*, which is a method, where the already developed product prototype is being tested in a Usability Lab with a group of potential users to see if it is acceptable and useful for the target group members. That process will often lead to development of additional improvements and making a second prototype. Traditionally the manufacturing companies are themselves developing the prototypes, innovating and making patents in their R&D (Research and Development) departments and only invite the users for the Usability Testing. As von Hippel describes it, "senior designers at firms have long been supplied by engineers and designers under their direct control, and with the resources to (...) construct and test prototype designs" (von Hippel, 2005). According to von Hippel it is still the vast majority of manufacturers that think that product and service development are always done by them, and that it is their task to find a need and fill it, rather than finding an innovation that lead users have already developed and commercialising it. Even though the innovation by manufacturers and usability testing was and still is widespread in many fields, it has been shown that "the traditional pattern of concentrating innovation-support resources on a few individuals is hugely inefficient" because it is hard to determine the right people who might develop a valuable innovation. (von Hippel, 2005).

There has been a shift in the recent years described by von Hippel as "Democratizing innovation", where more companies turn to *User Innovation*, also called *user centered innovation* or *user driven innovation*, when they introduce new Products or Computer Software. The concept of *User driven innovation* is described further in the next chapter.

In the field of Architecture the *Usability* concept is in principle well known for centuries. It was already mentioned in writing in Ancient Rome by Vitruvius (80-15 BC), who is famous for asserting in his book *De architectura*, also known as *The Ten Books on Architecture*, that

architecture must exhibit the three qualities of *firmitas, utilitas and venustas* — which means that it must be solid, useful and beautiful. (Wikipedia, 2010) Today most architecture students hear about the three elements in their first architecture history classes. Nevertheless the understanding of the words is not universal, but constantly changing throughout time and place.

According to Hillier and Leaman a building has four main functions (Hillier, B. and Leaman, A., 1976 in Voordt and Wegen, 2005): spatial organisation of activities, climate regulation, symbolic function and economic function. The spatial organisation of activities is described as building providing ‘optimum support for the activities desired by properly arranging the available space’ (Voordt and Wegen, 2005).

Moreover, *Utility* or *Usability* is often translated to a widely used term in architecture: *Functionality*. Architectural publications describe a *Functional quality* of a building as ‘its ability to fulfil the functions envisaged for it’ (Voordt and Wegen, 2005). The *functionality* of a building is also described together with all four functions listed by Hillier and Leaman, as the extent to which buildings’ spatial and physical qualities support functions of climate, symbol and economy as well as spatial organisation of activities (Voordt and Wegen, 2005). Nevertheless their summary of the concept of *Functional quality* of a building ‘refers to primarily to a building’s efficiency, practical usability or utility value, taking into account the financial means available.

The concept of *Architectural quality* was described by Voordt and Vrielink (1987) as an integration of: function - *functional quality*, form – *aesthetic quality*, construction - *technical quality* of and costs – *economic quality*.

In a field of facility services there has also been made a distinction between *technical quality* and *functional quality*, where the *technical quality*, as the core of the service process is often more important for the clients, but end-users working on premises see *functional quality* as more important. (Lehtonen, 2006).

During the last 5-10 years there has been a new development of research in *Usability* of buildings and workplaces. The research in usability has been centred around CIB W111 Usability of Workplaces which has produced reports with case studies as well as theoretical and methodological reflections (Alexander, 2005, 2008, 2010). The starting point has been in accordance with ISO 9241-11 to evaluate effectiveness, efficiency and satisfaction of workplaces and the built environment. Blackstad, Olsson, Hansen and Knudsen define *Usability of buildings* as: ‘Buildings true purpose is to support and shelter its users, while they are performing their activities and living their lives. (...) Depending how well they support their users’ activities, our physical surroundings contribute to efficiency, effectiveness and satisfaction in the user organisations’ (Blackstad, et al 2010).

Recently researchers have identified additional key concepts to usability (Alexander, 2008, 2010): Context, culture, situation and user experience that underlie efforts to understand and improve usability in the built environment.

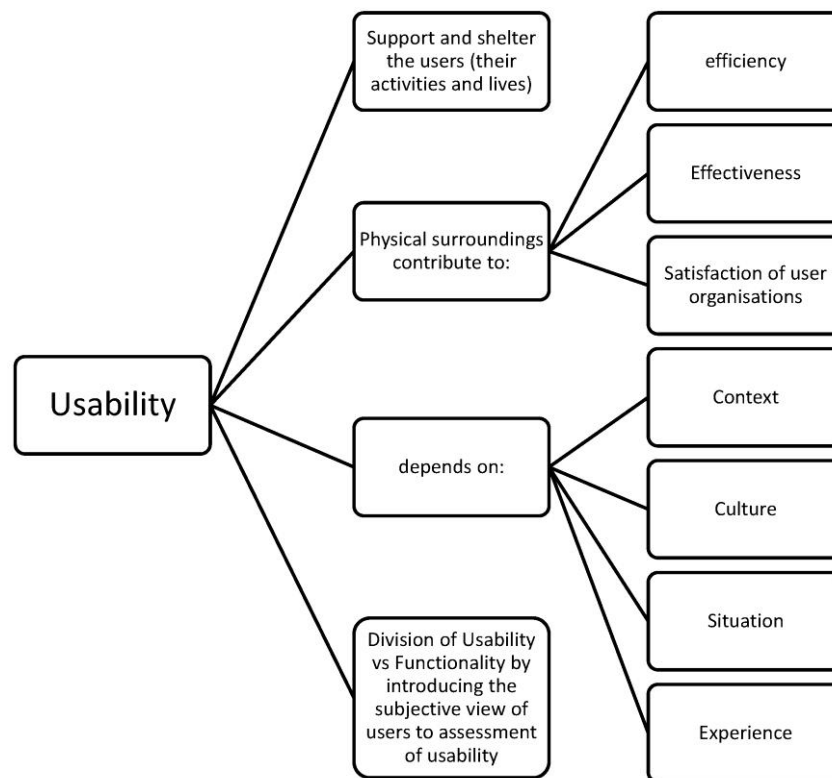


Figure 1 Recent understanding of Usability concept and its main ingredients

Alexander distinguishes between *Functionality* and *Usability*. He explains that it is ‘the use that determines the usability and not the presence of functions. Functions only make certain uses possible’ (Alexander 2006, 2008, 2010). Jensen supports the division of *functionality* and *usability*. He describes the traditional strong focus on *functionality* in the building industry, which is ‘based on technical rationalism, where the attributes of the products are described in objectively measurable terms’. He argues that the introduction of usability concept ‘challenges this approach of technical rationalism by introducing the subjective views of the users’ (Jensen 2010). The interesting result of this is that usability can be evaluated differently by different groups of users. That was the case in *Usability* evaluations of Norwegian university college, where students and staff had different perspectives and the results of usability evaluations of the built environment varied considerably (Hansen and Knudsen, 2006, at Jensen, 2010). Moreover, researchers claim, that evaluating *Functionality* would mean assessing “to which degree the building works according to specifications. *Usability* has a broader scope ... focus on how people utilise the functions to meet

their needs, and their experiences from doing so” (Blackstad et al, 2010). The graphical overview of the recent understanding of *Usability* concept and its main ingredients can be seen on *Figure 1*.

The most known usability assessment methodology is *POE – Post Occupancy Evaluation*. ‘Post occupancy’ refers to the fact that the building is already taken to use at the point of evaluation. The origins of the method are in the USA and it has been used since the 1960s. According to the definition of Preiser et al. (1988, 2005), POE is "the process of evaluating buildings in a systematic and rigorous manner after they have been built and occupied for some time". The British Council for Offices (BCO) suggests two main purposes for a POE. The main aim is to gain feedback of how successful the workplace is in supporting the occupying organisation and individual end-users. The other purpose is to use POE to assess if a project brief – the programme of requirements, has been met. Conventionally, the building occupants would answer questionnaires, participate in interviews and workshops. A few other tools, considered more objective, are also used as part of POE, such as environmental monitoring, space measurement and cost analysis (Wikipedia 2010). Traditionally POE is carried out by trained professionals or researchers with background in social sciences or workplace consulting.

Furthermore, recent international research points out that, “*usability*, with focus on the user perspective, is an often neglected aspect of building performance ... this seems quite odd as most planners, architects and facilities managers will claim that they are strongly concerned about the user perspective and the usability of the workplaces and buildings. The planners and building owners will claim that *functionality* of the workplaces is one of the important success factors for creating a good building. The well-being and satisfaction from the building users are also seen to be very important for some companies and FM-departments” (Hansen et al., 2005). From that perspective additional research in methods to improve usability focus in the design processes is of high value to all parties involved.

Recently the researchers have focused on developing methods for usability evaluations for a broader audience. This has partly taken place in the Erabuild-supported project REBUS (User-orientated Benchmarking for Usability and Sustainable Performance of Real Estates) and one of the results is the so-called USEtool from Norway (Hansen et al., 2009). The author group, Blackstad, Olsson, Hansen and Knudsen made a Usability mapping tool, the USEtool, which is targeted to be used by building owners and Facilities Managers. The research was a development process and a case study for three large Norwegian organisations, who can use the resulting toolbox themselves for assessing usability of their portfolio of buildings. The process has five stages. The first stage is “introductory identification stage (investigation of organisational objectives and relevant user groups), and a systematic general usability mapping and a walkthrough with more in-depth qualitative studies of specific usability topics. The last stages of the process include comparing findings with objectives, and developing recommendations for improvements in existing buildings

or briefing for new facilities” (Blakstad et al, 2010). The REBUS projects have also highlighted the evaluation and briefing, as well as support of the project management processes, as the key processes to achieve usability and effective facilities (Blakstad et al., 2010, Jensen, 2010).

Apart of evaluation of *usability* of existing buildings, there can also be focus on *usability* and *user involvement*. Alexander suggests that to improve usability ‘users must be empowered and communities must be offered the opportunity of meaningful involvement’. He argues that conventional appraisal methodologies are focusing too much ‘on the building as a subject and take functional perspective, rather than ... on the effect of the environment on users and ... processes’. User participation is limited in those processes and the potential for user empowerment is ignored. There is needed a change of perspective, ‘from building and its production, to users and the community’ (Alexander, 2010).

If the *Usability* of the future buildings shall be improved in general, there should also be focus on Usability in preliminary design stages for facilities, for example in *Idea generation* and *Briefing* for new built environments. It is also in those design phases where the user involvement can change much of the programme to improve the future usability and where changes are of low cost for the whole project. The important role of briefing on the final result of built environment was stressed in various publications, for example by Barrett and Stanley (1999) and Blyth and Worthington (2001), Jensen and Petersen (2009) and previously mentioned REBUS project (Blakstad et al, 2010).

CONCEPT OF ‘USER DRIVEN INNOVATION’

According to von Hippel, these days the innovation is being democratized, and it is no longer just the manufactures, but users of products and services—both firms and individual consumers—that are innovating. Von Hippel argues that user-centered innovation processes offer great advantages over the traditional manufacturer-centric innovation development, where the users rely on their imperfect agents. In addition to this, the individual users do not have to develop everything they need on their own, but can benefit from innovations developed and freely shared by others (von Hippel, 2005).

When discussing innovation, it is important to mention the concept of *lead users*. They are those users, who are ahead of the majority of users in their populations with respect to an important market trend, and they expect to gain relatively high benefits from a solution to their needs. Studies have shown that most innovating users have those characteristics, no matter if they are individuals or companies (von Hippel, 2005).

As mentioned in the previous chapter, traditionally manufactures develop and innovate by themselves and use patents and copyrights to protect their business. In this manufacturer-centric model of innovation, the users’ role is only to have needs and it is the producer’s role to try to

identify them and satisfy them by new products. In addition to that, manufactures sometimes invite the lead users for usability testing, where the advanced users can find additional improvements for developing the next prototypes. Generally speaking, it is the “users, who have a more accurate and more detailed model of their needs than manufacturers have, while manufacturers have a better model of the solution approach in which they specialize” (von Hippel, 2005).

Users needs were important to computer software development since the 1960's. A research group at Stockholm business school developed ISAC - a method that starts by considering the needs, problems, and ideas of the users, proceeding immediately to the specification of manual activities and computer programs (Floyd et al., 1989).

Already in 1989 Floyd et al. (1989) noticed a new trend of *User involvement* in software design and described it in the article *Out of Scandinavia: Alternative approaches to Software Design and Systems*. There were a couple of main characteristics of the new Scandinavian approach. The most important was the cooperation between developers and users, considered a crucial factor and getting methodological support. Furthermore various forms of prototyping were used to provide technical support for the process of mutual learning. The users were getting help to progressively qualify themselves for the process. The main goal was to adapt software to meet the needs of specific user communities. In addition to this the traditional participation approaches were extended by adoption of the two principles - mutual learning and designing by doing. The *mutual learning*, also called *co-learning* means, that both users and developers are reliant on mutual process of learning and communicating. The *designing by doing* means that there was experimentation and testing already in early stages, such as using prototyping and promoting communication and learning processes. Last, but not least a new concept arrived, that revolutionised the *User involvement* methods – the concept of *Co-creation*. The groundbreaking change was that now innovation and design was not done ‘with’ nor ‘for’ users, but ‘by’ users! (Ehn & Kyng, 1987)

In the recent years, we have seen in some fields that it is truly the users, who are first to develop most of new consumer products, as the computer software and communication possibilities are steadily growing, resulting in *user-centric* or *user driven innovation*. The surprising empirical finding is that users often freely reveal their innovations. The practices visible in “open source” software development were important in bringing this phenomenon to general awareness (von Hippel, 2005).

The recent shift to *User driven innovation* has very attractive qualities. Von Hippel describes two of them. First of all users easily get precisely what they want by designing it for themselves. Secondly the innovation by users appears to increase social welfare. Nevertheless there are some challenges to obtain a widespread *User driven innovation*. The manufactures must be able to apply the needed fundamental changes. Moreover, the governmental policy and legislation should stop supporting the manufacturers-innovation only (von Hippel, 2005). Furthermore, von Hippel summarises the

various qualities of User driven innovation in his book *Democratizing Innovation*, like this : “Users’ ability to innovate is improving *radically* and *rapidly* as a result of the steadily improving quality of computer software and hardware, improved access to easy-to-use tools and components for innovation, and access to a steadily richer innovation commons.” In addition to that, he predicts, that innovation by users will continue to grow, even if both users and manufactures have a constant willingness to invest in obtaining a precisely right product (von Hippel, 2005).

Generally *User driven innovation* methods can be divided into three groups:

- 1) lead user approach – first mentioned by von Hippel, where the lead users are gathered with the project team at workshops where fast prototypes are made, then R&D department develops further
- 2) ethnographical approach – the aim is to find the needs, both known and tacit, by studying the users in their everyday situations, the used tools can be: observations, workshops, interviews
- 3) Participatory design /innovation - the users are co-designers, methods can vary and are chosen to fit the exact project (Danish Enterprise and Construction Authority, 2010)

DISCUSSION / CONCLUSION

As described in previous paragraphs, the concepts of *Usability* and *User driven innovation* have several common features and benefits. The most recent understandings of the two concepts are summarised below.

Usability of the built environment is a quality of a building consisting of four elements: 1) Support and shelter the users, while they are performing their activities and living their lives, 2) Contribution to efficiency, effectiveness and satisfaction in the user organisations, 3) Dependence on context, culture, situation, experience, 4) Assessed by subjective view of users (unlike the functional quality that aims for objective data)

User driven innovation in the built environment is one of the methods of user involvement that can be used in planning new facilities or improving existing ones. Its main characteristics are that 1) users have most accurate model of their needs, 2) users are actively involved already at early stages, 2) there is co-learning and co-creation between the users and the designers (the participatory innovation), 3) democratised design process improves social welfare.

The question in this paper was *to what extent*, and *how* users can be involved in design processes to create better and innovative buildings of enhanced usability and if the concepts of *Usability* and *User driven innovation* are in unity or clash.

From one point of view, some fields would consider the *Usability* and *User driven innovation* as two clashing concepts, or that one – *Usability (tests)* is an older method that has been made

redundant by a newer method - *User driven innovation*. For example in product development there has been a shift away from the type of user involvement in the middle or end of the development process, where the users could give feedback on the usability of the product prototype and the result would most often be a development of a new prototype by the professionals. The new and more used method is *User driven innovation*, where the product is co-created by the users and designers together, and the process runs already at early stages of product development. Therefore *User driven innovation* leads to the situation, where there is no need to develop several finished prototypes, which must be tested and improved in several *Usability Tests*, because the developed product is co-created to fulfil the needs from the start. Those two understandings are indeed clashing.

On the other hand, there is an important fact, that the built environment is, unlike products, not developed as a prototype, which can be mass produced afterwards. Instead of that, each building is custom made, a prototype which is never repeated. Nevertheless, there is one exception - the standardised type family houses. Therefore in general, it means that the *Usability* of buildings cannot be understood as *usability tests* leading to more prototypes, but as a quality of a building.

Furthermore, it is easy to see the similarities in the two concepts. First of all, both concepts rely on the users and involve them. *Usability* can only be assessed with users, who can subjectively describe how well the facilities support their activities, and what are their experiences. *User driven innovation* can only occur with the active role of users in co-designing and innovating. The conclusion could be that *User driven innovation* is one of the user involvement methods to achieve a better *Usability* of facilities.

Additionally, there are a number of user involvement methods and they all might be used for planning new buildings. If the aim for the involvement is better usability, most of them can be used, but achieving better usability might depend on how strong is the usability focus of the design team and type of user involvement. *Usability* evaluations like POE – Post Occupancy Evaluations can be one of the tools. In the traditional understanding those tools would be used to evaluate existing buildings in use and possible make small improvements. *User driven innovation*, as a method of user involvement, which can be used from the beginning of the process of planning a new facility. In this method the focus is on satisfying the users' needs, innovation and co-learning and co-designing with the professional design team. The chances of *Usability* focus in the process of *User driven innovation* are even higher than in other user involvement methods.

However, *Usability* evaluations of buildings, like POE can potentially also be used in planning and briefing for new facilities. That thought comes from the common belief that users can and perhaps should be involved in much earlier stages of project development and in a much broader extent than traditionally in the building sector. One of the possible ways to achieve that is to make *Usability evaluations* at early design stages, in cooperation of the design team and users of buildings in use,

which are similar to the planned one. In that way co-learning can occur and there can be achieved a deeper understanding of users needs and potential possibilities. The claim is that would result in a better usability of the built environment.

Finally, even though the two concepts may seem to clash in some professional fields, we can see that understanding them as unity is potentially of great value to the built environment, which would result in being more usable and innovative. *User driven innovation* is one of the user involvement methods that easily approaches the task of planning a facility with a focus on *usability* and users' satisfaction and therefore is closest to *Usability*. Furthermore, *Usability evaluations*, when used in briefing and planning new facilities together with users, can further strengthen the cooperation and co-creation of the design team and users as well as potentially the focus on *Usability* of the entire design process. This unity of the concepts might be the ultimate step towards better usability of the built environment in the future.

The implications for the future research are the requirement of further future studies in using the methods in a broader audience, testing the results and showing the evidence to research community and practice. It is recommended to further test and evaluate the use of the concepts of *Usability* and *User driven innovation* in the practice of planning and evaluating of the built environment. This could be carried out in different contexts and potentially confirm the positive effects of user involvement and usability focus in planning of the buildings, which would make the results even more visible across the professional fields. Another question to be studied and answered is: who shall be responsible of those processes? There are several possible choices: the client and Facilities Manager, the architect, the competition programming advisor. Each might have their agendas. Further research in those topics is highly recommended.

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9.2. PAPER 2

Jensen, P. A., Alexander, K., & Fronczek-Munter, A. (2011). Towards an agenda for user oriented research in the built environment. In 6. Nordic Conference on Construction Economics and Organisation: Shaping the Construction/Society Nexus. (Vol. Executive Summaries - full paper in electronic proceedings (ISBN: 978-87-563-1514-2), pp. 55-56). Hørsholm: Danish Building Research Institute, Aalborg University.

TOWARDS AN AGENDA FOR USER ORIENTED RESEARCH IN THE BUILT ENVIRONMENT

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The background for this paper is the authors' participation in user oriented research in relation to the built environment and an aim to provide input to the future research agenda in this area for instance in CIB, who has recently taken an initiative to increase research focus on clients and users.

The purpose is to present an overview of different approaches to user oriented research and propose directions for further research that can help to give the users a stronger position to impact the built environment they experience.

The methodology is a literature review of research approaches like usability, user involvement in briefing, user driven innovation and participatory design. The different research approaches are presented, analysed, compared, and evaluated.

The paper suggests that further research in this field is strongly needed. The different approaches vary in theoretical foundations, methodologies and development, but they are in most cases not incompatible and they use many similar research methods. Further research should focus more on direct interactions with and involvement of users and mostly qualitative research methods should be applied in real life situations or simulations.

KEYWORDS: Usability, built environment, briefing, user driven innovation, participatory design.

INTRODUCTION

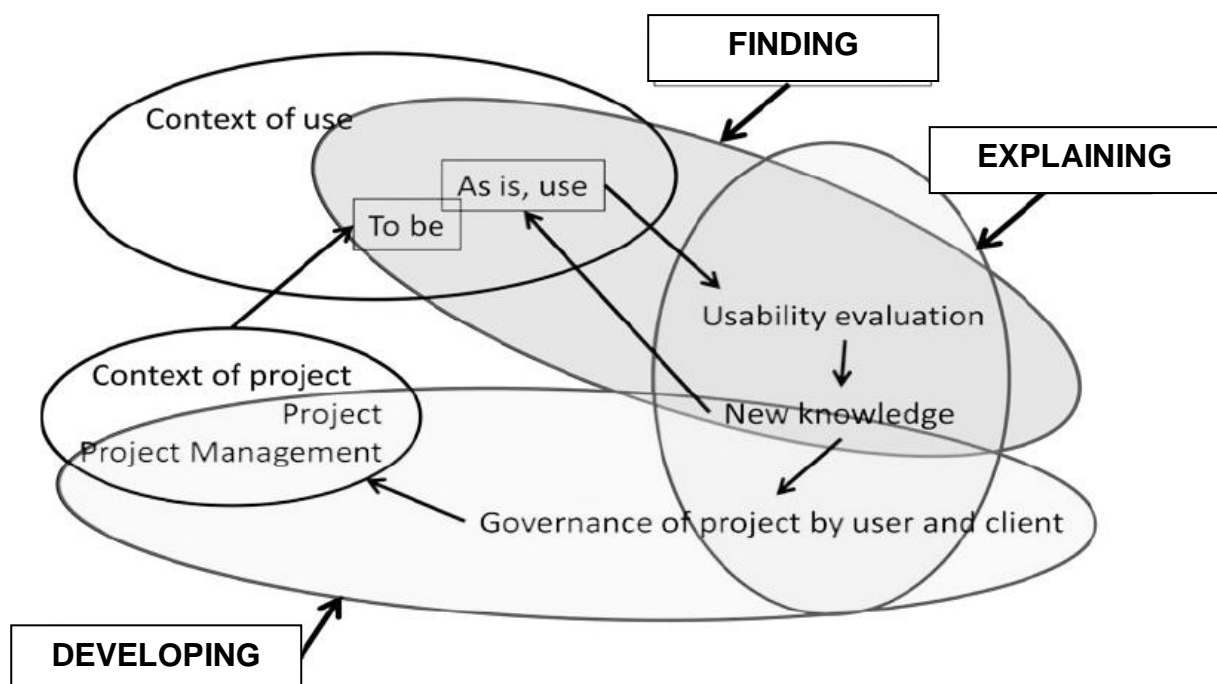
This paper aims to present current trends in user oriented research in the built environments and outline possible ways forward for research and practice to give the users a stronger position to impact the built environment they experience. The background is the authors' participation in user oriented research in relation to the built environment. This includes a leading role in CIB W111 Usability of Workplaces since its start. CIB has recently taken an initiative to increase research focus on clients and users by establishing a new working commission W118. This paper can be seen as an input to support this initiative but is also aimed at other researchers, institutions, funding organisations, and practitioners.

The starting point is a state of the art of recent research approaches like usability, user involvement in briefing, user driven innovation and user involvement in design. The methodology has been a literature review divided between the three authors according to their special areas of competences and fields of interest in relation to user oriented research. The paper has been developed during a number of meetings, a workshop, and exchanges of inputs and comments. The paper is exploratory and does not intend to cover all approaches of user oriented research. Areas like research on stakeholders and value management are for instance not included.

Recently, a large collaborative project on usability in the built environment - REBUS - was carried out in the Nordic countries with national projects in Finland, Norway and Sweden (Blakstad et al., 2010). One of the joint results was the model shown in Figure 1 which distinguish between the “As is” use situation and how new knowledge can be developed by usability evaluations and feed into action leading to a new “To be” situation. The overall management or governance of these processes is seen as crucial. The model was developed to map the different research carried out the three countries. For this paper we have used the REBUS model to map the different approaches of user oriented research that we have identified. For this purpose we have named the different places marked by the REBUS project as: Finding, Explaining and Developing. A fourth place could be Implementing or Executing, but this has not been relevant as part of this work.

The model is used as a basis for comparing the different research approaches towards the end of the paper after presenting the approaches. The paper is concluded with suggestions for further user oriented research.

Figure 1: REBUS model. Adapted from Blakstad et al. (2010)



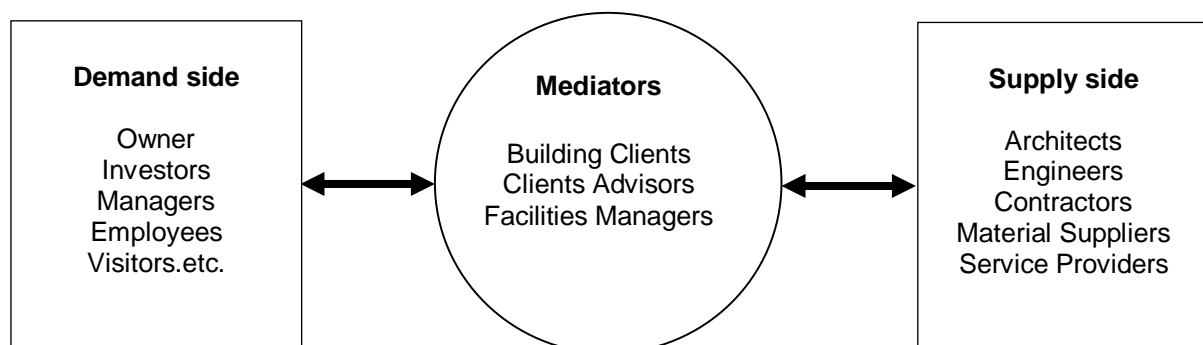
RESEARCH PERSPECTIVES

Clients and Users

So far research concerning building clients has been very limited even though there has been an increasing interest in the role of the client in many of the policy reports and development programs that has been launched in several European countries during the last 15 years. However, the interest for the client has mostly been from a supply perspective with a focus on the clients' role in relation to building projects. A typical example is Bertelsen et al. (2002), who discuss the possibility of the client acting as a change agent in relation to the building process as opposed to a more passive role as procurer. A complete opposite role is seen for instance in Public-Private Partnerships, where even the role as procurer is outsourced to a private consortium leaving the public organisation to the role as tenant specifying the demand to be provided by the supply side.

A more balanced view of the role of building clients is shown in Figure 2, where the building client is seen as a mediator similar to client advisors and facilities managers. The mediators are placed between the demand side and the supply side, and their role is to specify the needs from the demand side translated into requirements or service levels, which is in accordance with the professional language of the providers from the supply side. The need for such mediators in building projects and Facilities Management (FM) provision is due to the complexity and specialised character of such deliveries.

Figure 2: Clients as mediators. Source: Jensen (2002)



Building clients and facilities managers are often an integrated part of the demand side organisation, and the demand and their roles are very dependent on which type of organisation they represent. In business management and in FM it is common to distinguish between strategic, tactical and operational levels of organisations and interaction between FM and the core business part of organisations. This is even part of a European FM standard, where it is further defined that the interaction is with the client at strategic level, with the customer at tactical level and with the end user at operational level (CEN/TC348, 2006). A similar distinction is not common in the construction industry.

Users of the built environment have been discussed in many previous studies, but according to Olsson, et al. (2010), the term user is often oversimplified by assuming that there is only one group of users. Instead, it is proposed to structure the users in a model for user

categorisation based on a supply chain approach. The proposed common user roles are following:

- Owners
- Facilities management and service personnel (operating the building)
- Management of the organisation based in the building
- Service providers (examples: teachers in a school, doctors and nurses in a hospital)
- Service receivers (examples: pupils in a school, patients in a hospital)
- Indirect service receivers (examples: child's parents, patients' relatives)

Other useful, though more simplified distinctions of users are between demand and supply side by Kernohan et al. (1992) and the three kinds of users: the user, the owner and the facility manager, by Sæbøe and Blakstad (2009).

There seems to be a strong need for more research on the building client taking a demand perspective and looking at the client as organisations and to distinguish between the different organisational levels in relation to building projects and the involvement of users.

Usability

The concept of Usability is defined in ISO 9241-11 as: *“The extent to which a product can be used by specified users to achieve specified goals with effectiveness, efficiency and satisfaction in a specified context of use”* (ISO, 1998).

We have identified three different research traditions and perspectives. Usability engineering focuses on individual users of industrial products and IT-software. Usability and accessibility also focuses on individual users but in relation to the built environment and particularly the needs of less able users like disabled and elderly. Usability appraisal also focuses on the built environment, but the perspective is on users as parts of organisations seen from a FM point of view.

Usability Engineering

The concept of usability has its roots in evaluations of user interfaces of computer software and consumer products like electronic equipment. One of the seminal works is the American book by Jakob Nielsen (1993) on Usability Engineering. Here usability is seen in the context of system acceptability and as part of usefulness together with utility. The attributes of usability is defined as easy to learn, efficient to use, easy to remember, few errors, and subjectively pleasing.

Usability engineering is widely understood as Usability Testing, which is a method, where the already developed product prototype is being tested in a Usability Laboratory with a number of potential users to see if it is acceptable and useful for the target group members. That process will often lead to development of additional improvements and making a second prototype. Traditionally the manufacturing companies are themselves developing the prototypes, innovating and making patents in their R&D (Research and Development) departments and only invite the users for the Usability Testing. Even though the innovation by manufacturers and usability testing was and still is widespread in many fields, it has been shown that the traditional pattern of concentrating innovation support resources on a few individuals is hugely inefficient, because it is hard to determine the right people who might develop a valuable innovation (von Hippel, 2005). Usability testing is typical based on a man-machine relationship with individual users.

Usability and Accessibility

The concept of accessibility has over the last decades become increasingly important in relation to disability and the built environment. The concept has changed the focus from dealing mainly with physical access for wheelchair users towards enabling everybody, including persons with disability, to participate in the social and economic activities for which the built environment is intended. Accessibility is a basic feature of the built environment concerning the way in which housing, public buildings, places of work etc. can be reached and used.

The focus on accessibility was internationally brought forward by the United Nations, which in 1982 decided on a World Programme of Action on Disabled Persons and in 1993 agreed on Standard Rules on the Equalization of Opportunities for Persons with Disabilities (United Nations, 1994). This was followed by the European Concept for Accessibility in 1996, to be implemented in the national laws of all member countries. The European directive was based on the universal design principles, applicable to the design of buildings, infrastructure, and building and consumer products. The principles were the provision of safe and enjoyable environments that are accessible to everyone, and rejection of the division between able-bodied and disabled people (Goldsmith, 1997).

Iwarsson and Ståhl (2003) discuss the relation between accessibility, usability and universal design. Accessibility refers to compliance with official norms and standards, thus being mainly objective, while usability concerns fulfilment of functional requirements and is mainly subjective in nature based on individual interpretations. They see accessibility as a person-environment relationship and usability as a person-environment-activity relationship. They see usability as a more positive and complex term than accessibility and suggest that accessibility should be partly replaced by usability. They also highlight universal design as a more process-oriented and less stigmatizing concept than accessibility.

Inclusive Design is a further development from Universal Design. The first convention on Inclusive Design was held in London in 2000 and this led to the Stockholm declaration from 2004, where the definition of Inclusive Design was provided as “design for human diversity, social inclusion and equality” (Guida et al., 2008). In 2006 the United Nations adopted a Convention on the Rights of Persons with Disabilities, which unlike the World Programme from 1982 and the Standard Rules from 1993 is a legal binding document. It has to be ratified by the member countries and implemented in national legislation. Accessibility is one of the general principles of the convention (United Nations, 2006).

There has particularly in Sweden been some research of usability with focus on housing adaptations. An instrument for Usability in My Home (UIMH) has for instance been developed. This instrument is self-administered and consists of 16 items rated on a 7-graded scale targeting activity aspects, personal and social aspects and physical environmental aspects (Fänge and Iwarsson, 2003). This research appears to be very instrumental with a main focus on ergonomics.

Usability Appraisal

This section of the paper mainly draws upon the continuing research into the application of usability concepts to the built environment conducted by CIB W111 (Alexander, 2005, 2008 and 2010). The objectives of the research were achieved through a series of case studies and associated workshops designed to identify and evaluate the ways in which stakeholders in projects were involved in decision making about building use and the methods and tools they used. The research has enabled a number of broad conclusions about the nature of usability as

a concept and its application to the built environment and has challenged the basis of conventional approaches to briefing and post-occupancy evaluation.

In summary, the group sees usability as *'a cultural phenomenon that can only be improved through a better understanding of user experience, considered as situated action in a specific context'* (Alexander, 2008). The section discusses practical implications for built environment professions and for the development of management processes and raises specific issues for usability research in the built environment.

Much recent effort in construction research in Europe and particularly in the UK has been directed to creating 'a client-oriented, knowledge-based, value-based industry' (UK CTP/ECTP). Application of the concept of usability in the built environment presents a number of key challenges to conventional construction and property perspectives:

- User focus – usability places a focus on the user and the organisation rather than the building;
- Demand driven – usability recognises the dynamic requirements of organisations (and communities), derived from the strategic objectives;
- User experience – usability is primarily concerned with the perceptions of users rather than the intentions of designers and service providers;
- Contingency quality – usability is contingent on user values rather than an inherent function of the built environment;
- Context of use – consider facilities in the context of use rather than as a project (context of action);
- Process oriented - usability is considered as a process rather than as product or service provision;
- Service production – like all services, facilities are co-produced by service users;
- Relationship management – usability implies changing relationships with users;
- Learning process – usability exchange of knowledge amongst users, managers and service providers.

Fenker (2008) relates usability to user experiences and social relations between users and facilities and describes usability as a process that can only be understood as a social construction where the building act as a sort of stage. According to Fenker, *'...the artefacts are bearers of a set of possibilities and constraints as well as, most importantly, activity and social practices'*.

This was also reflected in the chosen theme of the recent CIB W70 conference in Sao Paulo – 'FM and the experience economy'. In his opening address, Da Graca (2009) introduced familiar themes that have been central to the Usability work over the past 10 years (following Pine and Gilmour's seminal work in service marketing) and argues that these should now be the focus of FM responsibilities. In the preface to the conference proceedings, Da Graca (2010) stressed the need to open the way to demand management focusing on the user experience. We need to understand user behaviour, user needs and user experiences and more: we need to manage and systematize the user experience (in a broad sense). We need to learn how to design experiences. Good FM briefings with good design. We have the necessary tools but we need to put them to work. He suggests that research in this area is essential. We need to practice FM which focuses on the User Experience (UX), looking at the demand side, managing experiences and putting the resources to work.

The most known assessment methodology for buildings is Post Occupancy Evaluation (POE), used since the 1960s. 'Post occupancy' refers to the fact that the building is already taken to use at the point of evaluation. According to the definition of Preiser et al. (1988, 2005), POE is *"the process of evaluating buildings in a systematic and rigorous manner after they have been built and occupied for some time"*. Conventionally, POE is carried out by trained professionals or researchers and the building occupants would answer questionnaires, participate in interviews and workshops.

The British Council for Offices (BCO) suggests two main purposes for a POE. The main aim is to gain feedback of how successful the workplace is in supporting the occupying organisation and individual end-users. The other purpose is to use POE to assess if a project brief – the programme of requirements, has been met.

Contingent user values are not easy to explore using conventional techniques such as POE and there have been calls for multi-method approaches (Blakstad et al., 2008) and a greater range of methods for understanding user experience (Alexander, 2008).

Usability evaluations are based on different user's experiences and assessments on how well the buildings perform regarding different parameters. A building's performance can never be seen or understood isolated from an organisational and technical perspective, as those aspects interact and influence each other. Usability has hence a complex nature and can be described as a "wicked problem" (Blakstad et al., 2008). Such problems are characterized by no definitive formulation of solutions, and they are open to multiple interpretations (Rittel and Webber, 1973). According to Blakstad, an adequate approach to "wicked problems" will require multi-method strategies using a triangulation of methods and evaluations with multiple perspectives.

This is in line with findings from previous studies showing that evaluations work best when they are based on several methods and aspects, depending on objective, purpose, focus, competence and resources (Frechtling, 2002). All this implies that usability evaluations are complex, that there is a need for simplification and that the evaluator possesses both theoretical and practical knowledge and skills (Baird et al., 1996). Blakstad et al. (2008) describes how different methods and tools were explored and tested according to their relevance and validity for usability in several Norwegian cases. As pointed out earlier, few of the available methodologies aim directly at evaluation of usability related to organizational objectives. However, they found that many traditional research and evaluation methods had potential to be developed for the purpose of usability evaluation.

User Involvement and Briefing

The traditional view is that briefing takes place before the design starts and the resulting briefing documents should contain the client's requirements for the building design. The brief is usually written by experts. Users are mainly involved as data sources, for instance via interviews and meetings with the experts. According to Nutt (1993), the nature and pace of change has challenged the simple basis of the traditional brief and exposed the limitations in the logic of its process. The future needs cannot be forecasted with confidence, hence the need for a dynamic process.

Prins et al., (2006) discuss the difference between static and dynamic briefing in relation to various procurement routes. They conclude that briefing has to include a well-balanced level of dynamic as well as static aspects. However, indirectly it seems to indicate an important distinction between briefing as a process and a brief as a document (or collection of

documents). The brief as a document is basically static, while briefing is, or should be, a dynamic process – at least in projects with an individual design. This suggests that briefing is more than writing briefs, and dynamic briefing should be a process of feedback to, and dialogue with, all stakeholders. Several authors regard briefing as an almost continuous process, for instance Barrett and Stanley (1999), Blyth and Worthington (2010), Fristedt and Ryd (2004), van der Voordt and van Wegen (2005), and Jensen (2006).

Nutt (1993) proposed the need for a strategic brief and also a facilities management brief - the former to provide a better link between the business operations and the building and the latter to include the operation and development of buildings through their lifetime. One of the main purposes of strategic briefing and user involvement in the briefing process is to ensure an alignment between on the one side business strategy and work process and on the other side the design of building and workplaces (Blyth and Worthington, 2001; Jensen, 2006). Fristedt & Ryd (2004) adopt the idea of strategic briefing as an activity in the pre-project phase, but they compliment the strategic brief by a tactical brief in the design phase and an operative brief for the construction phase.

From a review of the literature it is evident that there is no unified and generally accepted new way of briefing. However, there are some clear trends away from the traditional way of briefing towards what in a recent book has been called inclusive briefing (Jensen and Pedersen, 2009). Inclusive briefing is an interactive process, where the demand and supply sides are involved in a mutual dialogue process. Briefing concerns all the clients' and users' needs in developing a facility and is a continuing process with changing focus in different phases. Briefing is a process involving experts, but the experts are facilitating a guided learning and dialogue process with client and user representatives. The users should be actively involved, for instance in commenting on design solutions, and the involvement of the users is particularly crucial in building projects that are part of a corporate change process like introduction of new organisation, technology and ways of working. The end result of the briefing process is the acceptance of solutions, which have been developed based on a brief.

The recent work by CIB W111 on Usability has highlighted the importance of briefing as a means to achieve usability. However, this finding itself raises a further series of issues and a possible agenda for future research and has interesting implications for the way we think about briefing, particularly when usability is seen as a contingent quality rather than as the inherent functionality of the physical environment. Hudson (forthcoming) argues that much of the existing work on briefing is based on premises that it can be reduced to a rational process, it is part of a finite project, that the final outcomes of this project are buildings or other physical facilities and that user requirements have an external objective existence that can be captured in the briefing process. He goes on to suggest that work on usability suggests that these premises are limited and that a new approach to briefing may be necessary. This approach might be characterised by an emphasis of briefing as creative exploration of possibilities rather than requirements capture, a focus on the social construction of requirements and their evolution over time and a focus on human satisfaction rather than physical facilities.

Some of the characteristics of traditional, inclusive and usability briefing are summarised in Table 1.

Table 1: Traditional, inclusive and usability briefing. Adapted from Jensen and Pedersen (2009)

Traditional briefing	Inclusive briefing	Usability briefing
Concerns new building/construction	Concerns all client/user needs in developing facilities	Concerns user needs in existing facilities
A definite phase at an initial stage of construction	A continuous process with changing focus in different phases of building life cycle	A continuous process at different phases during occupancy
An expert based information collection	A guided learning and dialogue process	A co-learning process
Users mainly involved as data sources	Users actively involved as part of a corporate change process	Users as co-producers
The result is a brief, i.e. a requirement specification	The result is acceptance of solutions based on a brief	Brief as an evolving 'bulletin board'

Jensen (2006) has identified the following reasons as the most important for involving users in the briefing process:

- Ensure that new facilities are designed in accordance with the needs and intentions of the organisation
- Learn from good and bad experiences with existing facilities
- Ensure acceptance and appreciation of the new facilities among managers and staff

There is a need for further research in the role of the users in the briefing process and how to manage inclusive and continuous briefing with user involvement. There is also a need for research that evaluates the effects of user involvement for different types of users, processes, facilities and national cultures.

User Driven Innovation

According to von Hippel (2005), innovation is nowadays being democratized, and it is no longer just manufactures, but users of products and services that are innovating. In the traditional, manufacturer-centric model of innovation, the users' role is to have needs and the producer's role is to identify them and satisfy them by new products. In a user-centric model, manufactures invite lead users for usability testing and simulations, where the advanced users can find additional improvements for developing the next prototypes. Furthermore, he claims that most innovating users have characteristics of lead users - they are ahead of the majority of users in their populations with respect to an important market trend.

Ehn & Kyng (1987, in von Hippel, 2005) define user driven innovation as introducing a groundbreaking change - now innovation and design is not done 'with' nor 'for' users, but 'by' users! In the recent years, we have seen in some fields that it is truly the users, who are first to develop new consumer products, as the computer software and communication possibilities are steadily growing, resulting in user-centric or user driven innovation. The surprising empirical finding is that users often freely reveal their innovations. The practices visible in "open source" software development were important in bringing this phenomenon to general awareness (von Hippel, 2005).

According to Danish Enterprise and Construction Authority (2010), User driven innovation methods can be divided into three groups:

1. Lead user approach – first mentioned by von Hippel, where lead users are gathered with the project team at workshops, make rapid prototyping, then R&D department develops the product further
2. Ethnographical approach – the aim is to find the needs, both known and tacit, by studying the users in their everyday situations, the used tools can be: observations, workshops, interviews
3. Participatory design /innovation - the users are co-designers, methods can vary and are chosen to fit the exact project

The recent shift to User driven innovation has very attractive qualities. Von Hippel describes two of them. First of all users can get precisely what they want by designing it for themselves. Secondly the innovation by users appears to increase social welfare. Nevertheless there are some challenges to obtain a widespread use of User driven innovation. The manufactures must be able to apply the needed fundamental changes. Moreover, the governmental policy and legislation should stop supporting the manufacturers-innovation only (von Hippel, 2005). Furthermore, von Hippel (2005) summarises the various qualities of User driven innovation in his book *Democratizing Innovation*, like this: “Users’ ability to innovate is improving radically and rapidly as a result of the steadily improving quality of computer software and hardware, improved access to easy-to-use tools and components for innovation, and access to a steadily richer innovation commons.” In addition to that, he predicts, that innovation by users will continue to grow, even if both users and manufactures have a constant willingness to invest in obtaining a precisely right product.

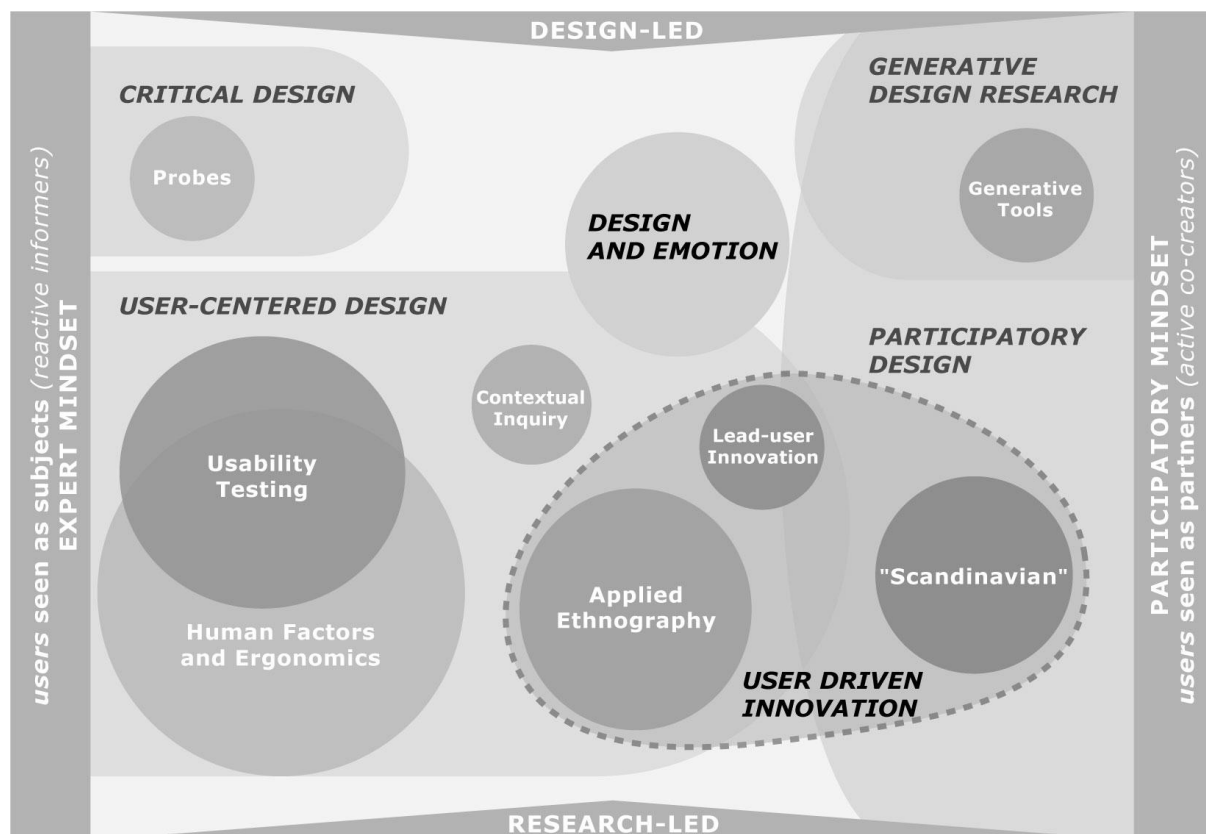
Research in user driven innovation has had a strong focus on products and software. As innovation by users is predicted to grow in the society, it is worth further examining of the possibilities of user driven innovation in the building sector. Furthermore, the different methods like workshops, rapid prototyping, simulations, interviews and observations can be applied and tested further in different stages of the design process.

User Involvement in Design

In recent years there has been growth and exploration of different approaches to design research. As some of them are complementary and others competing, the result was a confusing mess. Recently a visual map was presented by Sanders (2006) and Sanders & Chan (2007), which organises the landscape of design research and many of the approaches to user involvement, see Figure 3. The different approaches are positioned in the framework with two axes. The vertical axis is stretching from design-led to research-led, while the horizontal axis is stretching from an expert mindset, where users are informants and design is FOR people, to participatory mindset, where users are co-creators and design is made WITH people.

The largest area on the map is covered by the *User-centered design*, which is most developed according to the authors, and aims at developing products and services to better meet the needs of users. The approach is research-led with expert mindset. The main methods are *Human factors and ergonomics*, *Usability testing* and *Applied ethnography*.

Figure 3: Emerging trends in design research. Adapted from Sanders (2006)



Another large zone is *Participatory design*, which can be both design-led and research-led, and actively involves users throughout the design development. The origins date back to trade union movements in Scandinavia in the 1960s and later spread to other fields. For example the new trend was noticed in software design by Floyd *et al.* (1989), who described a couple of main characteristics of the new *Scandinavian approach*. The most important was the cooperation between developers and users, considered to be a crucial factor and getting methodological support. Furthermore, various forms of prototyping were used to provide technical support for the process of mutual learning. Users were getting help to progressively qualify themselves for the process. In addition to this the traditional participation, approaches were extended by adoption of two principles - mutual learning and designing by doing.

Mutual learning, also called co-learning means, that both users and developers are reliant on the mutual process of learning and communicating. *Designing by doing* means that experimentation and testing takes place already in early stages of a project, such as using fast prototyping and promoting communication and learning processes. Last, but not least a new concept of Co-creation arrived. Examples of the collective process, communication and co-creation of workplaces are described by Granath (1998). Moreover, Sanders & Chan (2007) add another characteristic to participatory design – “the use of physical artefacts as thinking tools throughout the design process”. Those tools - boundary objects - have been explored by researchers as Clarke and Fujimura (1992), Granath (1998), Kjølle and Gustafsson (2010). Recent examples of further research on participatory design are Broberg (2009, 2010), Binder and Brandt (2008), Peek and Geurts (2010), Våland (2010).

Lead-user innovation, as described by von Hippel (2005), is located in the map as a small overlap between User-centred design and Participatory design. If the definition of User driven innovation is broadened, as by the Danish Enterprise and Construction Authority (2010), then the overlap is covering the Scandinavian participatory design and Applied ethnography as well – see Figure 3.

Three other design categories described by Sanders & Chan (2007) are worth mentioning: *Affirmative design*, *Critical design* and *Generative Design*. Affirmative design, according to Dunne & Raby (2001, in Sanders & Chan, 2007) “reinforces how things are now”, conforms to the expectations and is the most used in design. Critical design rejects “how things are now” and provides alternatives to design and values. Generative design, on the other hand, focuses on creating tools for non-designers and empowering them to express their dreams for future or make their own alternatives to the current situation. Generative design is a part of the Participatory design zone, and is design-led.

It seems like there is a strong development of research in border area between User-centred design and Participatory design. Further research could explore the boundaries and the growing overlap of the two zones, as well as particular effects on specific fields, like the built environment.

COMPARISON OF APPROACHES AND TRENDS

The preceding section presented a number of different approaches of user oriented research. Research in relation to usability was divided in usability engineering with a focus on individual users of industrial products and IT-software, usability and accessibility with a focus on individual less able users of the built environment and usability appraisal with a focus on organisational users of the built environment. Usability appraisal is related to POE, but is distinguished by a stronger focus on feed-forward to the user organisation rather than feedback to the designers.

User involvement in briefing is specifically related to produce input into building design. User driven innovation is a broader concept coming from industrial product development with lead user innovation as a specific method. Participatory design is also a broad concept. When relating these concepts to the built environment, it seems important to distinguish between conceptual design and the physical design. The conceptual design focuses on the organisational needs of users and search for principal solutions to the configuration of functions and space. Briefing and user driven innovation can be part of this. Participatory design is more related to the physical design process.

Table 2 shows a comparison of these eight approaches in relation to purpose, typical setting of the user interaction, the place in the REBUS-model in Figure 1, and our estimation of their stage of development (status). We have as mentioned the introduction defined the places as Finding, Explaining and Developing. The five approaches Usability appraisal, POE, User involvement in briefing, User driven innovation and Lead user innovation all take a starting point in Finding and this is the main focus of POE, while Usability appraisal and User involvement in briefing also can include Explaining and Development, just like User driven innovation and Lead user innovation usually cover all three places. The three remaining approaches – Usability engineering, Usability and accessibility, and Participatory design – all have their main focus on Developing.

Table 2: Comparison of approaches of user orientation

Approach	Purpose	Setting	Place in REBUS-model	Status
Usability Engineering	Prototype testing of consumer products	Laboratory	Developing	Established
Usability and Accessibility	Design for disability, universal and inclusive design	Design office	Developing	Established
Usability Appraisal	Evaluation - feedforward (+ requirements and exploration of possibilities)	Existing facilities	Finding (+ Explaining + Developing)	In development
Post Occupancy Evaluation (POE)	Evaluation - feedback	Existing facilities	Finding	Established
User Involvement in Briefing - Traditional, Inclusive Usability	Define user requirements (+ dialogue and approval of building design solutions)	Existing facilities (+ design office)	Finding (+ Explaining + Developing)	In development
User Driven Innovation	Develop new products, processes or services and new or existing building design	Observation and interviews in existing facilities, workshops and/or innovation camps	Finding + Explaining + Developing	Emergent
Lead User Innovation	Develop new products or processes	Workshops and prototyping in R&D department	Finding + Explaining + Developing	In development
Participatory Design	Develop new or existing building designs in a dialogue process	Existing facilities, workshops and design offices	Developing	Established

The development of the user oriented approaches show two completely opposite trends. One trend is towards increased generality where the facilities should be usable for everybody and/or for changing purposes. This is expressed in the demands for universal design and adaptability. The other trend is towards increased specificity where facilities should be usable for specific activities. This is expressed in the focus on for instance optimal learning environments, healing architecture and housing adaptations for elderly. A way to compromise these divergent considerations could be to make the basic building dimensions and common areas like access, circulation and amenity areas as general as possible and make the specific activity areas as fit for purpose as possible.

SUGGESTIONS FOR FURTHER USER ORIENTED RESEARCH

This paper suggests that further research in the field of user orientation of the built environment is strongly needed. The literature review shows that the different approaches vary in theoretical foundations, methodologies and stage of development, but they are in most cases not incompatible and they use many similar research methods. Further research should focus more on direct interactions with and involvement of users and mostly qualitative research methods are needed. It is important to distinguish between different types of users and apply methodologies involving users both as individuals and in groups and organisations.

The following list a number of suggestions for future research. The suggestions are listed according to the places in the REBUS-model in Figure 1 as used in Table 2. Some of the suggestions are based on the REBUS-report (Blakstad et al., 2010) as indicated in brackets.

Finding

Approaches with focus on evaluation of the ‘as is’ situation could benefit from research in the following areas:

- Understanding building clients as organisations (strategic/tactical/operational)
- Role of the users in briefing etc. (REBUS)
- Evaluation of the effects of user involvement
 - For different types of users, processes, facilities and national cultures
- Management of the processes of evaluating usability (REBUS)

Explaining

Approaches with focus on creation of new understanding of the ‘as is’ situation and how it can be changed to a new ‘to be’ situation could benefit from research in the following areas:

- Knowledge management of transfer of usability data
- User involvement and tacit knowledge
- Usability briefing
- Investigation of feedback and feed-forward (REBUS)
- IT support of information flows (REBUS)

Developing

Approaches with focus on creation of a new ‘to be’ situation could benefit from research in the following areas:

- Management of continuous and inclusive briefing
- Briefing as creative exploration of possibilities
- User driven innovation in refurbishing, renovation and housing adaptations
- Agile management of participatory design
- Simulation as method for user driven innovation
- Management of decisions on strategic, tactical and strategic levels
- Management of user experiences

It should be stressed that this paper and these results are part of work in progress and does not intend to cover all aspects of user oriented research in the built environment. Thus, it should be seen as a contribution to the further development of this important area of research.

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9.3. PAPER 3

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FACILITATING USER DRIVEN INNOVATION – A STUDY OF METHODS AND TOOLS AT HERLEV HOSPITAL

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ABSTRACT

Purpose: To present the preliminary research results of user driven innovation methods at healthcare facilities and their relevance to research and practice.

Background/Approach: The paper is based on a case study conducted at the Gynaecologic Department at Herlev Hospital as part of Healthcare Innovation Lab, which is a public-private collaboration project testing the simulation and user-driven innovation between users and companies at Hospitals in the Danish Capital Region. The theories presented are user driven innovation, usability and boundary objects.

Results: This article presents different methods used in planning of new hospital facilities and the experiences with using them in practice to improve usability of the built environment. The study focuses on the initial stages of the design processes, specially ‘user driven innovation’ – the participatory design process in which users are actively involved as co-creators. The paper describes the process and its phases, as well as reflects on the results of the user involvement and specific methods. Depending on the methods used at the workshops the participants/users had different focus, changed the priorities and developed different solutions.

Practical Implications: Advice on process and use of boundary objects for future workshops with user groups

Keywords: user driven innovation, hospitals, methods, boundary objects, usability

1 INTRODUCTION

Healthcare facilities are recently getting a lot of attention in Denmark, because there are planned 28 hospital projects in next 10-15 years. This includes both new hospital sites and buildings and redevelopments of existing ones. There is also focus on the initial stages of the design processes, specially ‘user driven innovation’ – the participatory design process in which users are actively involved as co-creators, with the aim of acquiring modern hospitals that support the needs of future patients, healthcare professionals and society.

This article aims at presenting the results of user driven innovation at healthcare facilities, which are particularly relevant and interesting for research and practice, because of the variety of different users and major changes in treatment and technology. Best practice examples of the facilitation methods and objects are also relevant with concluding general advice for future workshops with user groups to achieve innovative and usable building designs.

The paper is based on a case study conducted at the Gynaecologic Department at Herlev Hospital as part of Healthcare Innovation Lab, which is a public-private collaboration project testing the simulation and user-driven innovation between users and companies at Hospitals in the Danish Capital Region. The case study is a part of my PhD project about usability briefing for hospitals, which includes studying the methods and results of user involvement in design. My interest in participating in this case was to observe the ways of involving users in planning healthcare facilities.

The article is structured as follows. First, the relevant theories of user driven innovation, usability and boundary objects are shortly presented. Then, the approach is described. The following section presents the results from the case study and provides further analysis of the different methods and tools used at the workshops in planning new hospital facilities. The experiences and results of using them in practice to improve usability of the built environment are summarised. The process of user involvement is described with the phases, and specific methods and objects used are evaluated. Finally, general conclusions are taken and subjects for further study are drawn.

2 STATE OF THE ART

2.1 User driven innovation

According to von Hippel (2005), innovation is nowadays being democratized, and it is no longer just manufactures, but users of products and services that are innovating. In the traditional, manufacturer-centric model of innovation, the users' role is to have needs and the producer's role is to identify them and satisfy them by new products. In a user-centric model, manufacturers invite lead users for usability testing and simulations, where the advanced users can find additional improvements for developing the next prototypes. Furthermore, he claims that most innovating users have characteristics of lead users - they are ahead of the majority of users in their populations with respect to an important market trend.

Ehn & Kyng (1987, in von Hippel, 2005) define *user driven innovation* as introducing a groundbreaking change - now innovation and design is not done 'with' nor 'for' users, but 'by' users! In the recent years, we have seen in some fields that it is truly the users, who are first to develop new consumer products, as the computer software and communication possibilities are steadily growing, resulting in user-centric or user driven innovation (von Hippel, 2005).

The recent research in the Nordic region defines user driven innovation as "*the process in which knowledge is being retrieved from users to develop new products, services and concepts. A user-driven innovation process is based on an understanding of user needs and a systematic involvement of users*" Rosted (2005), Wise and Høgenhaven (2008).

According to Danish Enterprise and Construction Authority (2010), user driven innovation methods can be divided into three groups:

- Lead user approach – first mentioned by von Hippel, where lead users are gathered with the project team at workshops, make rapid prototyping, then R&D department develops the product further

- Ethnographical approach – the aim is to find the needs, both known and tacit, by studying the users in their everyday situations, the used tools can be: observations, workshops, interviews
- Participatory design /innovation - the users are co-designers, methods can vary and are chosen to fit the exact project

Research in user driven innovation has had a strong focus on products and software. As innovation by users is predicted to grow in the society (von Hippel, 2005), it is worth further examining the possibilities of and experiences with user driven innovation in the building sector. Furthermore, the different methods of user participation and involvement like workshops, rapid prototyping, simulations, interviews and observations can be applied in the process of user driven innovation and tested further in different stages of the design process.

2.2 Usability

The concept of *usability* has its origins in product development and the definition by ISO 9241-11 is following: *“The extent to which a product can be used by specified users to achieve specified goals with effectiveness, efficiency and satisfaction in a specified context of use”* (ISO, 1998).

Usability has been researched in a number of studies, with different focus topics and a variety of understandings are widespread. The main direction of usability research has been the development of theory and methods to capture and evaluate usability to improve existing facilities and to feed forward to new building projects. As my research is focusing on developing the process of usability briefing for healthcare facilities, I am interested in how to plan the facilities, which are usable for the users. I will therefore in this article use the following understanding of usability (Fronczek-Munter, 2011):

Usability of a building is a quality, where

- the building supports and shelters the users and their activities, buildings true purpose (Blackstad, et al 2010).
- contributes to efficiency, effectiveness and satisfaction of user organisations, (ISO, 1998 reformulated by Blackstad, et al 2010).
- depends on context, culture, situation and experience (Alexander, 2008, 2010)
- is, unlike functionality, a matter of subjective view of users (Alexander 2005, 2008, 2010, Jensen 2010).

The literature shows a possible focus shift towards usability and *user involvement*. Alexander suggests that to improve usability *“users must be empowered and communities must be offered the opportunity of meaningful involvement”*. He argues that there is needed a change of perspective, *“from building and its production, to users and the community”* (Alexander, 2010).

If the *Usability* of future buildings shall be improved in general, there should also be focus on Usability in preliminary design stages for facilities, for example in *idea generation* and *briefing* for new built environments. The important role of briefing on the final result of built environment was stressed in various publications, for example by Barrett and Stanley (1999) and Blyth and Worthington (2001), Jensen and Petersen (2009) and REBUS project (Blakstad et al,

2010). Recent work by CIB W111 on usability highlighted the importance of briefing as a means to achieve usability. The characteristics of traditional, inclusive and usability briefing were listed by Jensen et al. (2011). Furthermore, there are a number of common issues of *usability* and *user driven innovation*, which lead to conclusion that *user driven innovation* can be seen as one of user involvement methods to achieve *usability* of planned facilities (Fronczek-Munter, 2011).

2.3 Boundary objects

The term *boundary object (BO)* was developed by Star and Griesemer (1989) as a concept of problem solving by means of translation.

Boundary objects are described as media of communication between communities. They can be abstract or concrete objects that arise over time from durable cooperation and understood or misunderstood in equality between the participants. The concept has been described further by several researchers, eg. Clarke and Fujimura (1992) define boundary objects as including things, tools, artefacts and techniques, in addition to ideas, stories and memories of community members. Several researchers, *e.g.* Kjølle and Gustafsson, (2010), Carlie (2002, 2004), Wenger (2000) and Broberg et al. (2011) have been studying the use of BO in literature reviews and case studies of briefing and design processes or product development, and concluded with dividing them into following types and categories:

- Repositories (ie. cost databases, parts libraries),
- Standardised forms and methods (ie. drawings, handmade sketches, lists of problems, questionnaires),
- Objects, models and maps (ie. slideshow, CAD 2D-3D, fishbone chart, mock-ups),
- Discourses (ie. questioning situation, typical action situation),
- Processes (ie. prototyping, visiting other departments)

In addition to that, Broberg et al. (2011) made a list of characteristics of boundary objects. The 4 most relevant for this case analysis are the following:

- BO are not ready made, but *objects-in-the-making*, need to be created by participants
- BO have *built-in affordances*, possibilities for action, interaction instruments
- A *facilitator* of the events selects the BO, develops rules and instructions and guides the workshops
- BO are used in discrete events, workshops with a *temporary learning space*, enable a collaborative design process, enable participants into “design mode”

Several other publications on boundary objects can be studied further, Boujut and Blanco (2003), Vinck et al. (1996), Wenger (2000).

3 METHOD / APPROACH

I will use the concept of boundary objects in an understanding of different tools and objects used in workshops. My criteria for analysing and evaluating results with BO are the following: First, how well do they help communication and innovation? Are they easy to use and understand for

all participants? Are they bringing new ideas? Second, what is the effect of BO on design solutions?

The three theories described in the previous section can be combined to describe and analyse the case study. In the case study, the involvement of users was executed as a user driven innovation process. Furthermore, the boundary objects were used as tools at workshops and the goal, among others, was to generate ideas for a new workplace, a healthcare facility of high usability.

I, as a Ph.D. student at the Technical University of Denmark, participated in the HIL A project as one of the facilitators, whose role was mostly to observe and facilitate the process, but at few events we were also participants and co-creators of the result. It means that user driven innovation is then of two types: design “by users” and sometimes “with users”. Compared with the traditional design “for users” the case provided an excellent best practice of the extensive user involvement.

4 RESULTS FROM CASE STUDY

This section will present the case study. First sub-section includes general information about the case study. In the next sub-sections the three phases of the HIL project A process will be described separately. For each phase the characteristic methods, tools and boundary objects used in the workshops will be described with accompanying reflections on the process. Each phase findings are the evaluations of the methods and objects, as well as their impact on the design results. The last sub-section presents general findings and conclusions about the whole process and involved users.

4.1 Description of the case – general information HIL

The case study was conducted at the Gynaecological Department at Herlev Hospital as part of Healthcare Innovation Lab (HIL). HIL is a development project which aims to demonstrate the feasibility of establishing a permanent healthcare innovation laboratory. It involves users, hospitals, scientific and research institutions, patients and relatives, as well as companies. The users at HIL are widely understood as the medical staff. The HIL project is funded by the Danish Enterprise and Construction Authority's program on user driven innovation.

In the beginning of 2010 the objectives and success criteria of the HIL project and its part projects were specified. The studied case is the HIL project A, focusing on functional and organisational planning of hospital facilities. It consisted of observations, workshops and simulations with users at the Herlev Hospital in the period September 2010 - June 2011. The chronological overview of the process and methods is presented in Figure 1.

4.2 Description of process and findings of Phase 1- Exploring

At the first meeting the facilitators and users discussed the developing of a future concept. It was important for the group to start with an agreement on the aims and expectations, so the planned activities would run smoothly.

Figure 1: Chronological overview of the process and methods at HIL project A



The methods and boundary objects used were post-its with written individual wishes and comments, which were placed on a round bull-eye target poster in order to communicate and prioritise the needs of both groups (Figure 2). The result of the prioritising game 1 about expectations was a set of rules and agreements for further observation at the department, staff and patient involvement in the project. It provided a common understanding of the special legal and ethical conditions of user involvement at the healthcare facilities with respect for clinicians, patients and relatives. It also secured goodwill of cooperation with the user team. The boundary objects seemed to be easily understandable and fitted to the task.

Workshop 2 was an exciting experience for all participants, where the user group and the facilitators were innovating together. The goal was defined as: creating visions for future, defining patient flow in steps through department and prototyping of treatment room. The workshop was loosely structured and the roles of participants were not defined clearly. The boundary objects were blank posters, colourful post its, markers, Duplo figures and blocks. The workshop was very productive, but created opposite and unpredictable results from the two subgroups. One user group was bound to present reality, while defining the patient steps through physical design, but was innovative in prototyping phase and future patient types/needs. They invented a Royal Model, where medical staff comes to a patient room with mobile equipment instead of patients going around the department for specific treatments. The other user group, on the other hand, had untraditional visions, but reduced them to traditional solutions when doing prototyping. The positive conclusion was that in general it is possible to change and innovate with staff and the workshops are very productive. The critical conclusions of the facilitators were the awareness of a need for clearer rules to user exercises in future workshops and the need of clear roles for both users and facilitators. Another critical conclusion was the need for a more specific definition of expected aims and structure of each exercise to achieve a uniform result, as the user groups seemed a bit too free and unfocused at times. Nevertheless, the workshop

resulted in some useful results: defined a typical patient flow in steps, provided with some expectations of future patient types and needs and invented a Royal model concept.

The following step was a number of observations at the department (Figure 2), where the facilitators observed specific topics: staff-, patient- and journal-flow and how well the physical environment supports the activities. The individual lists of issues on the three topics were gathered into a common list of challenges in the department. The facilitators achieved a better understanding of the daily routines and issues that need to be addressed in the future plans. The following presentation of the list of challenges in a short and condensed form was recognised by users as an understanding of their recent position and the need of changes.

Figure 2: Phase 1 - Exploring, 1 - Workshop about expectations and 3 - Observations at the outpatient department



The Boundary Objects used in the phase 1- Exploring were of three categories. The first two workshops used *objects*: posters and post its. The third activity, the department visit, was of BO category *processes*, but also used the *standardised forms* in the lists of issues. All of the BOs were easily understood by the users and had strong characteristics of BO - they were actively created by participants, gave possibilities for action, and enabled participants into “design mode”. The facilitators learned the fourth important characteristic of BO during the workshops – the need of rules and instructions.

4.3 Description of process and findings of Phase 2 - Development

The next stage was a new series of 4 workshops with users which took place at Herlev Hospital. The facilitators prepared the process thoroughly at meetings beforehand and chose potential best tasks, tools and objects that can ease the collective process of communication and design. The expectations to outcome were addressed as well. The facilitators took single roles to play – some were structuring the meeting, some asking questions to specific topics, some were observing and taking notes and some videotaping. The users exclusively discussed the future needs and designed the future possible solutions with each other. The facilitators could inspire or provoke for other solutions than mentioned, but it was the users taking decisions and working on the

design. The boundary objects were paper posters, post its and markers and the facilitators were guiding the users through the task by asking relevant questions and helping drawing the maps according to the given answers.

The results of the event 4 were communication maps showing the variety of tasks involving others, different to each specialisation. Exercise 5 resulted in an overview of different task processes of the specialisations. Finally the break downs were identified and marked visually on both of the maps. The conclusion after the tasks 4 and 5 was that structuring the process and roles was helping to gain a comparable result for each user group. The process maps- 5 showed also how the view on the patient flow and staff process varies and depends significantly on belonging to particular professional group of the medical staff.

The workshop with design games – 6 and 7 - was very productive and remembered by all participants. The first task for users was a design game called Ovals – 6 - or Flower. The boundary objects were a poster with abstract oval forms, small papers with icons/photos/names of rooms, and a possibility to make new ones and placing them according to users' own rules and common agreements. The task was to translate the drawing freely and organise the functions accordingly (Figure 3). The participants were very excited and discussed the understanding of the task and possible solutions. The ideas were innovative and discussions covered both physical and organisational topics. The result was a design of 3 levels with common areas in a central position, and all patients arriving the same place. Another new idea was a command bridge with a coordinator.

The next design game was Squares - 7. It was meant to continue and further detail the solutions from previous exercise. The boundary objects were also a poster, but this time with a square grid printed on it, yellow and blue squares, icons and names for room functions and Duplo person figures to play staff or patient flow through. The task for the user group was to distribute functions and rooms and organise them with yellow squares for rooms with access to staff only, and blue squares for areas with patient access (Figure 3). The participants felt more restricted by more realistic square rooms, and only one level solution, but tried to keep and translate previous ideas to new rules – kept the central place and many related functions close to each other.

The design results of the exercises 6 and 7 was a functional plan of rooms, first divided in 3 levels, then forced to 1 level, defined physical proximity of functions, corresponding to wishes of the group and imagined expectations of the future patient. Another, unexpected result was a list of needed organisational changes for the future and the awareness of many assumptions and preconditions to organisation, technology, etc. Those were listed by the facilitators on a separate poster while the users discussed the issues.

Phase 2 used BOs of several types. The *Standardised methods* were drawings and handmade sketches. The *Objects and maps* examples were communication map, printed posters, Duplo person figures. There were also following *Repositories*: parts libraries in form of icons, names and pictures for rooms. Another type of BO was *Discourses* in the form of typical action situation in tasks 4, 5, 6 and 7 or questioning situation in design games 6 and 7, where the standard design and organisation solutions were questioned and new ones provoked. All BOs used in phase 2 worked well as interaction instruments with the given rules and enabled a collaborative design process. They were prepared by facilitators and were created by users

during workshops. The combination of boundary objects in form of well prepared design games with Objects and Discourses was the most entertaining, productive and innovative.

Nevertheless, the designing process with ovals – 6 - seemed more playful for the users and more frustrating when using squares - 7. The interesting question is what was special about the design game 6 and 7 that the group responded so differently to them and the innovative results seemed easier/harder to obtain? The boundary objects and the task seemed quite similar, but it was much easier for the users to freely distribute the functions, have an overview of the whole department and innovate in the abstract oval forms, than in the more realistic squares. The conclusion is that the abstract BOs were more playful, free and easy to use and enabled the users into “design mode” easily. The BOs in squares on the other hand, were more serious and started many new discussions about details, for example access to daylight and the solutions changed several times depending on the current focus.

Figure 3: Phase 2 – Development, 6 – Ovals design game, 7 - Squares design game



The general conclusions from phase 2 are the following. First, the tasks for users shall be structured and planned in advance and boundary objects chosen carefully to give the expected type of results, which can be for example more innovation and new ideas or specifications of details and prioritising of focus areas. Furthermore, the facilitators must be open to hear also other relevant results than planned, and support them too – here the facilitators got aware of a new topic with preconditions and started listing it simultaneously on another poster.

5 DESCRIPTION OF PROCESS AND FINDINGS OF PHASE 3 - VALIDATION

At workshop 8 - square concept validation - the results from previous design game were developed further and validated through playing specific patients' flow through them. The boundary objects were the previous posters with room arrangements, but included also typical patient stories to be played through a Duplo person that was being moved around the plan. The finding from that workshop is that the patient stories and the playing of the real patient through the future hospital helped the participants to change and optimise the plan further to fit as many

patient's and staff's future wishes and needs as possible. On the other hand the changes were minor and innovative spirit was missing.

The task 9 - 3D - design aimed at further validation and development of the users' concept for the future facility. The boundary objects used were 3D visualisations of specific areas in the future department (Figure 4). The pictures and plans were prepared beforehand by the facilitators and students according to the notes from the previous user workshops. It seemed to be a great start of new discussions about new topics like the atmosphere and look of the areas, the organisational issues together with interior details and furniture, as well as technical solutions to medical treatments and glass doors. The reality of the pictures allowed the user group to make their previous thoughts more precise. The users presented their results to the department management. The facilitators prepared the slides with updated notes on specific topics and the updated visualisations of the specific rooms. The group seemed very content to see their results looking so professional and real and were very engaged in telling the story. The structured and visual presentation slides may also have eased the process of presentation and explanation of the complex problems and solution ideas. Unfortunately the photorealistic 3D visualisations of the solutions had a weakness of focusing on the room sizes, furniture design and colours, and not so well showing the innovative solutions of the users, which were the organisational changes, proximity and arrangement of functions. If both should be represented in a professional way, then the user group should have had the designing architects involved in the workshops too.

Figure 4: Phase 3 – Validation, 9 - 3D design, 10 – Simulations



The last event type was a number of simulations - 10. The boundary objects in simulations were paper sheets, empty boxes representing rooms, colourful post its, markers, Duplo figures representing patients and medical staff, egg timers, typical patient flows and typical disruptions. The tasks were to arrange the room boxes on the table and play typical patient flows through department in steps with specified time use (Figure 4). The users and facilitators were playing one figure at a time, moved it between the rooms, drew the walking lines with markers and set the allowed time for each step with the timers. Time in the simulations was played with the speed x3, so the simulations were fast. The first simulations were representing single patient, doctor,

secretary and nurse, but later the number of participants was 10-15 and more realistic. The aim was to test the basic models of functional and organisational plans and evaluate the effectiveness, quality and overview. The exercise was very dynamic and quickly the previous solutions were abandoned and new ones developed by the group. The Royal model from phase 1 was tested too and found ineffective, because of waste in staff time use. Several other concepts and new “what if” ideas were tested. The common reflections of users and facilitators led to development of a new model – the “star concept”. It has a coordination function, like in phase 2, now placed in the central room for medical staff. From here the doctors and nurses have access to the patient’s examination rooms arranged around it, in which the patients stay for both the conversations and examinations. The central coordination room is innovative for outpatient clinic both functionally and organisationally. It was easy to make an immediate simulation of the new concept and later test it with users from other hospitals that proved its potential qualities.

The boundary objects in phase 3 were various. Exercise 8 reused “old” BOs from squares - 7 - and was lacking innovation. The 3D models - 9 - were not made by the users directly, their ideas were translated and modelled by others. The table simulations – 10 - were flexible, quick, easy to use and surprised by not only allowing the quick tests of models, but also the strong potential for new innovations. The validation of concepts, turned into innovation and development of new, improved concepts.

6 GENERAL FINDINGS – PROCESS RESULTS AND USERS

The workshops concentrated on the physical environment. The facilitators got aware that most of the workshops actually had not one, but several parallel themes of innovation. They could be divided into 3 themes:


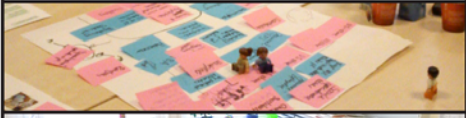








- physical environment, rooms, needs, qualities and locations, functional plan
- organization, professional roles and activities,
- preconditions for the future solutions,

The finding was that some of the organisational roles have to be redefined and there are a number of political and technological preconditions for the future solutions to be possible to achieve and turn the basic functional schemes to hospital of high usability.

Each workshop and the used boundary objects, previously described in the phase descriptions are summarised and evaluated in Figure 5.

The active workshop participants in the HIL project A can be divided into two groups: users and facilitators. The users in this case were the medical staff including doctors, nurses and medical secretaries, while the facilitators were researchers, consultant companies and various specialists. There were also professionals, who followed only parts of the process as observers, i.e. management from the department and the architect representing new building processes at the hospital, responsible for the client briefing process, competition and coordination with external architects and designers.

Figure 5: Overview of workshops at HIL project A, used boundary objects and their evaluation

Photo	Name, BO	Evaluation of Boundary Objects
	1 Expectations, Bull-eye target poster, post its, markers	Easy to use actively, communicate and prioritise, making common agreements
	2 Patient flow, Post its, markers, room prototyping	Innovative visions - Royal Model, traditional physical design, uneven results in groups, need for rules
	3 Observations, BO Process: Observing, hearing stories, listing of issues	Better understanding of the department, list of challenges,
	4 Map of Communication, Blank poster, drawing arrows showing communication	Easy to make, gives overview of tasks and communication between people, breakdowns
	5 Patient flow, Colourful post its, markers notes, arranging steps-fish-	Productive, easy to arrange patient steps and staff tasks - overview
	6 Design game Ovals, Poster with abstract ovals, icons and photos of rooms	Flexible, playful, free task, result: innovative ideas to organisation and building, users in "design mode"
	7 Design game Squares, Square grid, room icons, colourful squares	Restricted to reality, serious, frustrating, details development of functional plan, discussing the building
	8 Square concept validation, Square rooms, patient flow, Duplo figures	Small changes in arrangements, optimisation, no innovative spirit
	9 3D design, 3D visualisations of chosen areas	Discussing details, furniture, atmosphere, immediate changes by participants not possible, professional look
	10 Simulations, Room boxes, Duplo figures, patient flow, disturbances, egg timers	Testing basic models & innovating, easy, quick to test usability, organisation and functionality, new scenarios

There were no patients or architects involved actively in the workshops. There were users participating only in some workshops, e.g. the Senior Hospital Physician at the event 1 and 2, which disturbed the continuity of the user involvement process, as the Royal Model did not get support and ownership from the new user group. The observing architect, representing the client was not co-creating the results, which could have been helpful in the designing and 3D modelling, which in this case was done by others, who were neither part of the group, nor the responsible architects. Moreover, the competition for new facility was already running at the time of the workshops, so the designing architects already received a functional brief, but also couldn't participate in workshops, as there were several competing companies.

There are several types of users of the built environment. Recent research organised them in some groups, depending on various criteria. Kernohan et al (1992) divides them into demand and supply side, Alexander to client-buyer, Norwegian studies, like Haugen 2008, Sæbøe and Blackstad 2009 - mention the user, the owner, the facilities manager. The article "Who is the user?" (Olsson, N.O.E. et al. 2010) divides the users into 6 user categories, including client organisation professionals, service providers and receivers.

Users actively involved in the case were limited when looking at the panorama of potential users. The workshop participants were mostly medical staff. Patients were not involved at all in the workshops, but were represented alone in the focus of staff on patient needs and types and a few interviews. There are several other types of users of the built environment mentioned in literature and some groups were strikingly missing at the workshops, for example the architects and FM Managers or support staff.

I see a broad picture of the users/stakeholders in hospitals. Apart of medical staff, there are patients and their relatives, client organization (managers, facilities managers and architects), support staff and various external consultants (architects, engineers, designers, work environment specialists etc). The society is an important user in two understandings. First, the individuals are potential patients and relatives, or users of hospital facilities, e.g. public spaces, meeting rooms, cafes. Some are direct neighbours. Second, society is an owner of public hospitals as taxpayers and voters, organised in governmental, state and regional authorities as well as media.

7 CONCLUSIONS AND PRACTICAL IMPLICATIONS

After the series of workshops with user groups, some main conclusions can be made. The series of workshops had 3 phases and each resulted in a main innovative idea. The exploring phase resulted in a Royal Model, where the different doctors visit the patient's room. Phase 2 developed the Coordination Bridge and central room for patients. The Validation phase 3 not only tested the previous models, but further developed them into a new Star Model, with central room for medical staff and coordination.

Depending on the methods used at the workshops the participants/users had different focus, changed the priorities and developed different solutions. Some of the BOs, the Ovals design game - 6 - and Simulations - 10 - were most innovative. Both can be characterised by being flexible, open for translation and abstract. The conclusion is that those BOs were more playful, free and easy to use and enabled the users into "design mode" with focus on future needs and design of innovative solutions. On the other hand, other BOs, as Squares - 7 - and 3D design - 9 - were more serious and seemed to lock the participants to current situation and details or were more demanding.

The users actively involved in the case workshops were extremely limited when looking at the panorama of potential users and did not include patients, architects or facilities managers. The user categories at hospitals could be studied further with their potential roles in the planning of new facility and type of involvement.

The use of the workshop results at HIL could also be studied more thoroughly. The workshops in the case did not result in usability briefing; the architectural competition was running parallel already. Nevertheless the results might be used in future workshops with the architects that won the competition for the new hospital. The question to be answered is: how will and could results of such workshops be used?

My recommendations for future workshops about planning hospital facilities are following. First, start the process early, so the results can be used for competition brief. Second: invite a broader range of users and keep the same people in the group. Furthermore, make a strategic plan of user involvement, some shall be actively involved, some only informed and some make decisions. Moreover, plan the aims of each workshop exercise, structure the tasks and roles of individuals, and finally choose the tasks, games and boundary objects carefully to fit the expected focus and type of result.

Further study is recommended in other methods of user involvement for briefing for new facilities, apart of involvement in design workshops and simulations. Another method, which was not tested, is evaluation of buildings in use. All relevant methods could be described and results compared. The questions to be answered are: Which methods could improve the design processes with the ambition of creating better and innovative buildings of enhanced usability? How optimal process could look like?

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9.4. PAPER 4

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Evaluation methods for hospital facilities

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ABSTRACT

Initial position & background: There are various methods and tools for evaluating facilities. The focus is usually on the technical building performance, function/usability or form/beauty. Examples are: Post-Occupancy Evaluation (POE) and Usability Appraisal. Nevertheless, evaluations of buildings in use are seldom. They are considered a long and expensive part of the final phase of a building project. Therefore the experiences of finished building projects are not collected and mistakes are repeated.

Problem & task description: This paper lists different types of evaluation methods ordered according to focus areas and proposes which evaluation methods to use in different building phases of healthcare facilities. Hospital evaluations with experts and users are also considered; their subjective view on space, function, technology, usability and aesthetics.

Results & solutions: This paper presents the different methods for evaluating buildings in use in a new model, the Evaluation Focus Flower, and proposes which evaluation methods are suitable for various aims and building phases, i.e. which is giving best input for the initial briefing process of new hospital facilities with ambition of creating buildings with enhanced usability. Additionally various evaluation methods used in hospital cases in Denmark and Norway are presented. Involvement of users is proposed, not just in defining requirements but also in co-creation/design and evaluation of solutions. The theories and preliminary research results have relevance to researchers and practitioners planning new complex facilities, of any kind, not only hospitals.

Keywords

Evaluation methods, Hospitals, Briefing process, POE, Usability Appraisal

1 INTRODUCTION

There are various methods and tools for evaluating facilities. The focus is usually on one of the three: the technical building performance, function/usability or form/beauty. Nevertheless, evaluations of buildings in use are seldom. They are considered a long and expensive part of the final phase of a building project. Therefore the experiences of finished building projects are not collected and mistakes are repeated.

My focus is on planning usable complex facilities, like hospitals with multiple challenges of healthcare sector. In Denmark there are currently 28 (16 new) hospital building projects that will shape the future for a long time ahead. They can probably be planned more optimally, resulting in better usability, if the building process, especially the briefing stage is enhanced with evaluations to support decisions.

This paper proposes a way to organise evaluation methods according to focus area and how to choose the right evaluation method for different buildings phases of new healthcare facilities. A new model, the Evaluation Focus Flower, for sorting methods according to focus area is presented. An additional model proposes evaluation methods that can be used at different phases of a hospital building project, specially focusing on early stages and briefing process.

The article is structured as follows. Section 2 presents a literature review on POE, a detailed overview of various methods and the new models structuring various evaluation methods. Section 3 describes three hospital cases in Denmark and Norway. Section 4 covers analysis of how the methods could be used in hospital projects at different phases. Finally section 5 presents the conclusion.

2 EXPLORATION OF EVALUATION METHODS

2.1 Reasons for evaluation

Several reasons exist for making evaluations. Cold (2012) divides them under 3 groups:

- Recognition - To understand the place and yourself, experience, understanding, development of theories
- Control - To see others' experience and use of place, control and get abilities/ knowledge
- Professional information - To know expert evaluations, discuss and inform

The British Council for Offices (BCO) suggests two main purposes for a Post Occupancy Evaluation (POE). The main aim is to gain feedback on how successful the workplace is in supporting the occupying organisation and individual end-users. The other purpose is to use POE to assess if a project brief – the programme of requirements, was met.

Researchers recently presented additional aims of making a POE - to gain knowledge from own and other sites and *feed forward* for new briefing processes (Jensen, 2010, Preiser, 2010, Lindahl, Hansen, Alexander, 2012). This use of POE methods for new building projects is called Pre Design Evaluation (PDE) (Ornstein and Andrade, 2012, Preiser and Vischer, 2005).

I recommend combining POE / PDE with user involvement and co-learning, making a common understanding in the participant group (Fronczek-Munter, 2012).

A model combining those aspects is presented in Figure 1 and shows various reasons for evaluations of buildings. The model has two axes.

The horizontal axis is inspired by innovation thinking and shows the amount of action and innovation level in the building.

The vertical axis adds the context:

- Existing building, (either testing current existing conditions, or knowledge applied for improvements or radical innovation in same facility)
- New building, (testing if requirements are met, learning from other existing facilities and feed forward for briefing and innovation in a new building, part of user involvement and co-learning process)

- Develop generic knowledge (documentation of best practice case in specific type of building or geographical area, inspiration to innovation – many cases)

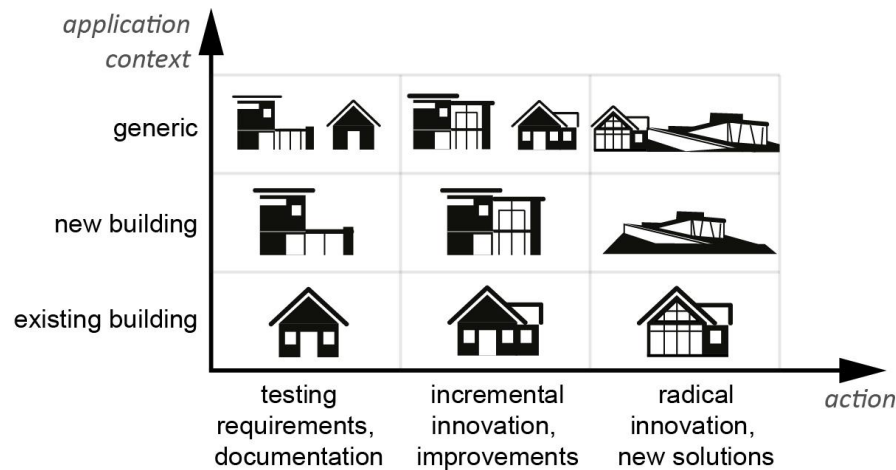


Figure 1 Model of the various reasons for evaluations of buildings

Comparable to the methods of user involvement, which I recommend to choose carefully to fit the expected focus and type of result (Fronczek-Munter, 2011), I also recommend to be aware of an organisation's motivation for doing evaluations and in advance choose the focus areas and methods to support the aims.

2.2 Methods of evaluation

Once the goals of the evaluation are clear, a suitable method can be chosen. In order to assist that process I have organised the different methods from literature review in Table 1. Additionally, I have developed a new Evaluation Focus Flower model, see Figure 2, for an easy overview of methods and their main focus. The POE method is described in two understandings: the traditional common practice and a broader "umbrella" understanding, in which all the further methods can be used.

2.2.1 POE

The most known evaluation method for buildings is Post Occupancy Evaluation (POE) (Preiser, 1988, 1995, 2003, 2005). 'Post occupancy' refers to the fact that the building is already taken to use at the point of evaluation. The origins of the method are in the USA and it has been used since the 1960s. According to the definition of Preiser et al. (1988, 2005), POE is "the process of evaluating buildings in a systematic and rigorous manner after they have been built and occupied for some time".

There are 3 levels of detail in POE, (Preiser, 1995, 1988, 2003, Blackstad, 2008):

- *indicative* - quick, walk-through evaluations, involving structured interviews with key personnel, group meetings with end-users, inspections. Result is a quick overview of positive and negative aspects of building performance, gained with limited use of resources

- *investigative* - in-depth evaluations, interviews and survey questionnaires, photographic/video recordings, physical measurements, benchmarking with literature and state of the art facilities. Result is in depth evaluation of the facility
- *diagnostic* - longitudinal and cross-sectional evaluation studies of performance aspects, comprehensive, many variables, research approach. The result is knowledge from state of the art descriptions from cases.

The POE approaches have evolved from case studies of stand-alone building projects, to structured studies of varied building forms with valid, cross functional results for benchmarking (National Research Council, 1987). The critique of traditional POE was that it usually focuses on technical building performance. Nowadays the term for such technical focused assessments is commissioning. Jensen (2010) proposes, that evaluation of usability complements commissioning activities in a combined validation of both the technical and the user oriented performance of buildings, and that the processes could run continuously, like the continuous briefing (Jensen et al., 2009), but with different peak times. Riley et al. (2003) present the historical development of POE, also previous resistance to POE by construction professionals. Preiser (2010) recently states that POE /PDE is a proactive process which feeds into the next building cycle through strategic planning/ needs analysis and programming/briefing. The broad understanding of POE, is that it evaluates the performance of the building based on user experiences, but also considers a more holistic, process-oriented evaluation (Preiser and Vischer, 2005). The clients are interested in POE to improve their facilities and occupants' performance (Bordass and Leaman, 2005).

POE practitioners are usually architects, but according to Preiser (2010) they will be trained in several other disciplines in the future, also in social sciences/management. Nevertheless other kinds of participants can run POE or PDE: managers and design team with user groups, personnel and end-users.

2.2.2 Overview of evaluation methods

There are over 150 POE techniques available worldwide (McDougall et al., 2002, Leaman, 2003, Bruhns, Bordass, Leaman, 2005, Blakstad, Hansen, Knudsen, 2008, Riley et al. 2009, Haron, Hamid, 2011). Some are well established: Mental Map (Lynch, 1960), Save (1990) others are more recent: USEtool (Hansen, Blakstad, Knudsen, 2009). Some of the different methods of evaluation are presented in Table 1 and Figure 2 with typical focus areas.

Figure 2 provides an overview of the methods, grouped and placed on the Evaluation Focus Flower model in order to easily find the right evaluation method fitting the focus area to study. The many focus areas are represented by flower petals with overlaps. The model background are three main areas, that are based on three qualities of architecture, that were defined in Ancient Rome by Vitruvius (80-15 BC) in his book *De architectura*, also known as *The Ten Books on Architecture*. The qualities are: *firmitas*, *utilitas* and *venustas*. Today most architecture students hear about the three elements in their first architecture history classes. Nevertheless the understanding of the words is not universal, but constantly changing throughout time and place. *Venustas* will be translated in this paper as Beauty / Form, *Firmitas* as Durability / Technology, and *Utilitas* as Utility / Usability.

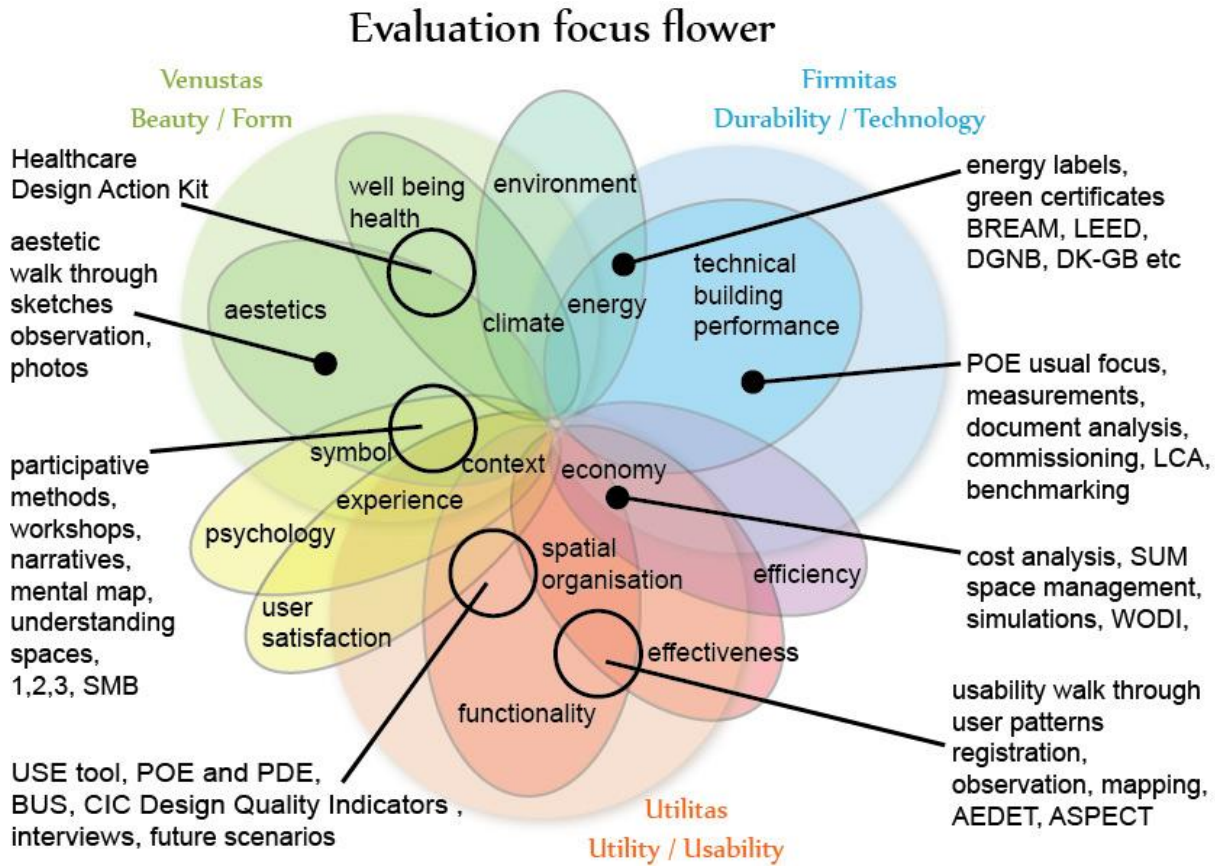


Figure 2 Evaluation Focus Flower model with a few evaluation methods placed accordingly to their main focus

In Table 1 the methods are grouped and explained, and generic methods that can be used in various focus areas are added.

Table 1 Different methods of building evaluation and their main focus. Numbers refer to references

Method	Tools used	Focus
Generic methods		
Benchmarking (23,26)	comparing standard data from own evaluation to others	Generic method, often energy, space utilisation
BRE Design Quality Method (DQM) (22)	Studies of architecture, interior, comfort, life cycle cost, user satisfaction - questionnaire	Architecture, interior, comfort, life cycle cost, user satisfaction
Document analysis (2,17)	Study of documents, drawings etc.	Generic method for various use
Interviews (2,17)	Individual or group interviews	Generic: current use of space, explore experiences of users, satisfaction, efficiency, existing work practice, context
Learning from experience (4,5,36)	- Facilitated group discussions or interviews	Team learning from its experience

Observation, documentation, photographs (2,17)	Observation of facilities, their use and focus topics, documentation, photographs, experience, test, learn	Generic method: beauty, usability, technology
Overall Liking Score (22,36)	Questionnaire (Hardcopy/web based) 7 point scale	Occupant survey. Diagnostic tool
Participatory methods (2,17)	workshops, narratives (story telling), pictures, personas, future scenarios, simulations	Generic method, get various inputs from stakeholders, co-learning
POE broad understanding, PDE (pre-design evaluation) (4,5,18,26,36)	Questionnaire, space measurement, walk-through, survey, focus groups, forum, facilitated group discussions, interviews, workshops	Generic method: Functionality, building quality/impact, user satisfaction, productivity, added value of FM, sustainability, workplace management, aims: testing, monitoring, co-learning, input to decisions, beauty, usability, technology
Survey/ questionnaire (2,4,5,17)	Questionnaire	Generic method: usability, work style and pattern, culture, efficiency, satisfaction
Walk-through, excursion (2,17) A walk around the block (9,25) Observing physical traces- Behaviour vs. Design	Walk-through – structured route and focus areas, positive and negative aspects, walk with everyday users and visitors excursion – free route	Generic method: usability, aesthetics, technology, functional design, behaviour and appearance
Beauty		
Mental map (9,25)	Drawing important places on a map, comparison, discussion	Remembered and used physical spaces of the city, our different relations to them
Place understanding (9,28, 29)	Understand : the causal - intentions, the formal /configurative – the form, the semantic - symbolic	aesthetical expression of a place or architecture, intentions, form and symbolic value
Townscape, Serial vision (9,12)	Systematic sketches and notes	Experience the city space through movement, systematic visual, perception, position, form, changing experiences in continuous movement
Place identity and role (7, 9)	Interviews, workshops: assessment of interaction of physical environment, activities and people's perceptions, culture, cognitive ecology	Identity of a place as interaction of physical environment, activities and people's perceptions, dynamic and will change when factors change
Semantic differential scheme (9,19,21)	Scheme with 8 parameters, i.e.: complexity, originality, pleasantness, people's immediate experience and evaluation of places, comparisons	Comparing people's immediate experiences, beauty, psychology
SAVE (1990) Survey for Architectural Values in the Environment (9,27)	Mapping architectural values of cities, municipality atlas. topographic, historic, architectonic analysis	City's dominating features, structures, character of topographic, historic, architectonic value
1,2,3 method (9)	1- <i>immediate impressions</i> - sketches and notes. 2- <i>analysis</i> , 3- <i>consolidated place assessment</i>	Place and architecture evaluation, preliminary impressions and feelings about space confronted with scientific analysis

Usability		
AEDET, ASPECT, QIND, CIC DQI (18,22)	Study by designers, not users	Help in design process, functionality
BUS Occupant survey (Building USE Studies), OBU Healthcare POE Method (4,5,22,23,26,36)	- Building walk-throughs - Questionnaire backed up by focus groups	Occupant satisfaction productivity, comfort
CIC Design Quality Indicators (4,5)	Questionnaire	Functionality, building quality/impact
De Montfort method	forum, walk-through	Broadly covers the process review and functional performance
Healthcare Design Action Kit (22)	Checklist for managers, architects and a patient inquiry about building in use	Hospital supporting patients and relatives
Healthcare Design Quality Assessment Method (22)	Many qualitative tools i.e. questionnaire with open questions	Design , architectural solutions, effect on users
Interaction model for the emotional process (Küller, 1986, 1991)	Observations of the physical environment and users/ patients behaviour, mood, social behaviour, activities, resources, eating patterns, etc.	Users relations to physical environment, functionality, psychology. Studies show i.e: homey interior affects wellbeing
Mapping, analysis of space and relations (2)	Analysis of space and relations between them, observations, interviews, organisation, mapping	Space utilisation, functionality, organisation
Overall Liking Score (4,5)	User survey on comfort and well-being	Comfort , well-being of users, how important are various conditions
PROBE, (4,5,22,23,26,31,36)	Questionnaire/- Focus groups/- Visual surveys, energy assessment, evaluation Performance of systems	User satisfaction / occupant survey Systems performance, building engineering benchmarks developed
Quality of city space and 3 types of activities (15)	Systematic assessment of quality through observation of necessary, optional and supplementary (also social) activities in city spaces	City spaces of good quality will have many of optional and supplementary activities
ST&M, ASTM standards (22,26)	measuring if requirements are met	functional requirements test
USE tool (1,2,16,17)	Usability walk-through, user survey, process guideline - the organisation can make it without experts, 5 phases: defining, mapping, walk-through, workshop, action plan.	Usability of the facility, functionality, user satisfaction, productivity
User patterns, time/activity/space studies example: SUM space utilization monitor (CfPB) (2)	self reported and registered study of time/activity/space	Space utilisation
Technology		
BRE Design Quality Method (DQM)	Questionnaire	Architecture, indoor climate, Life Cycle Cost (LCC), user satisfaction
Commissioning (20)	Testing technical installations, measurements, calculations	Validation of performance, interplay of technical installations, life cycle

Energy Assessment and Reporting Methodology (4,5,23,36)	Energy use survey, data collection e.g. from energy bills	Energy use and potential savings
LEED, BREAM, DGNB, DK-GB (26)	Energy measurements, levels	Energy labels, green certificates, high goals, proving excellence
POE traditionally, BPE (Building Performance Evaluation) (4,5,22,23,26,31-35,36)	Questionnaire, Energy assessment, environmental monitoring, space measurement, cost analysis, data collection e.g. from energy bills, interviews etc.	Testing if aims are achieved, systems performance, benchmarks, energy use
WODI, WODI Light (CfPB)	Web based questionnaire	KPIs database, employee satisfaction, productivity

3 HOSPITAL CASE STUDIES

To show a sample of the varied use of evaluation methods used currently in hospital projects I present three recent cases.

3.1 Healthcare Innovation Lab (HIL), Herlev Hospital, Denmark.

The case study was conducted at the Gynaecologic Department at Herlev Hospital in 2010-2011 as part of Healthcare Innovation Lab, which was a public-private collaboration project testing the use of simulations and user-driven innovation between users and companies at Hospitals in the Danish Capital Region.

I participated as one of the researchers in a number of design and simulation workshops with a user group from the outpatient clinic. One evaluation method was a scenario-based table-top simulation, a series of evaluations of possible new spatial arrangements and working organisation. The simulations have proven to be both time efficient, easy to understand and use for all participants and very innovative in both process and results. The user group succeeded in developing an innovative concept of the future outpatient clinic in terms of spatial layout, work organization, knowledge sharing and technology.

This case has proven that evaluations can be one of the activities for involvement of users at workshops for developing new clinic facilities, but also that evaluation can lead to innovation.

The workshops took place while the architectural competition for new design of the hospital was running. I would suggest using the simulation method either in the *briefing stage* to evaluate alternatives for the future or in the *design stage* to evaluate the preliminary sketch design solutions.

3.2 St Olavs Hospital, Norway.

I have conducted a test of parts of Use tool at Laboratoriesenteret at St. Olavs Hospital, Trondheim, Norway as part of a PhD course "Evaluation of architecture" in November 2012. I guided a few co-students from the course for a walk-through at Laboratory Centre. The route had 4 stops where we observed the focus points Aesthetics and Usability, made notes and discussed our analysis. To finalise I made a pilot test of USE tool survey at 2 locations. The results of USE tool were: broad overview of the facility, structured observations and group summary, but also surprising additional information about usability from user questionnaire. It can be concluded, that for a full overview the observations must be followed up by questionnaire filled at site by employees. The evaluation was not part of the hospital project. It must be noted that the process

was not a full USE tool test, but only parts of it, but it gave valuable inputs, that could be used for *briefing* of other hospitals.

3.3 Bispebjerg Hospital, Denmark

This case study took place in Bispebjerg Hospital, Capital Region in Denmark in 2010-2013, where I observed the processes of briefing and user involvement for a major redevelopment of the whole hospital at its site. One of the evaluation methods used was Study trips/excursions – a less structured walk-through process, where the managers and client project group visited other sites for inspiration. The focus was often one specific area ie. logistics, and the location was chosen as the best case within exactly that theme. Interesting cases were not only hospitals, but also other buildings: hotels, airports, to observe the best systems running smoothly. Another evaluation method was User patterns and space utilization, time/activity/space studies. These were run as preliminary studies of used and empty rooms, done by an external party and served as basis for area calculations. Both methods were used in *briefing stage* of the project.

4 HOSPITAL BUILDING PHASES AND SUGGESTED EVALUATION METHODS:

As building performance and usability assessments are complex, they require multi-method strategies using a triangulation of methods and evaluations with multiple perspectives (Lindahl, Hansen, Alexander, 2012). Case studies have shown that hospital projects use various evaluation methods for different reasons. I present a generic example model of evaluation methods with different aims, suggested to use at different phases of hospital projects, in Figure 3.

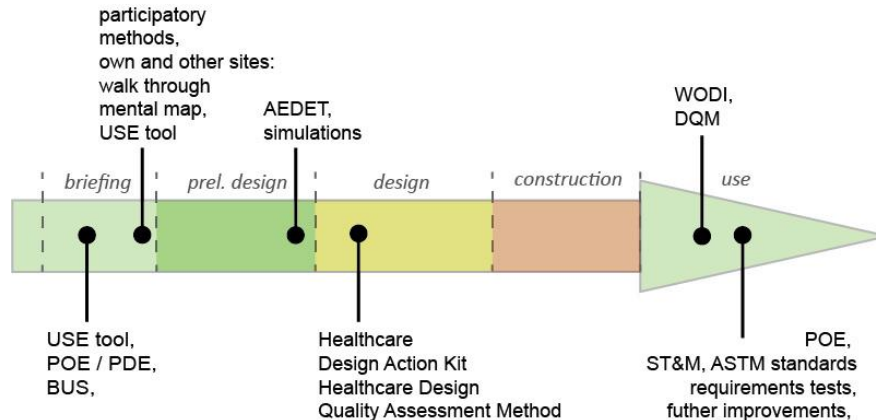


Figure 3 Example model of evaluation methods used at different phases of hospital projects

In the *briefing phase* for new healthcare facilities I propose running usability evaluations of buildings, like POE or PDE (Pre-Design Evaluation) also evaluating alternative scenarios (Ornstein, Andrade, 2012), USE tool, mental map and participatory methods. I suggest that “users can and perhaps should be involved in much earlier stages of project development and in a much broader extent than traditionally in the building sector. One of the possible ways is to make *Usability evaluations* at early design stages, in cooperation of the design team and users of buildings, which are similar to the planned one. In that way co-learning can occur and there can be achieved a deeper understanding of users needs and potential possibilities. The claim is that would result in a better usability of the built environment” (Fronczek-Munter, 2011). Some of the evaluation methods can be run on own existing facilities for future comparison, and for

learning which areas need improvement and which are ideal and need to be kept. There should also be walk-through evaluations of best cases, both for inspiration in terms of beauty, usability and technology, but also to provide a common base for the project participants.

In the *preliminary design stage*, I suggest evaluation methods that help the architects in the early process, methods such as User patterns and Learning from experience. The team can get valuable and structured information about space utilisation and uncover the previous experiences, in order to rethink and innovate from the current situation and together with the client choose the right scenarios for the future.

The following *design phase* is where main decisions have already been taken, but there are still lots of complex design solutions that need to be chosen. In order to optimise that process some evaluation methods can be used to learn from other locations and experiences, methods like Adet and especially for hospital projects the Healthcare Design Action Kit to help the functionality issues. Another possibility is running simulations of the preliminary design solutions, which can possibly find improvements in how the architecture and layout can support the future organisation.

The *construction phase* has legally specified procedures for evaluations.

In the *use phase* I suggest running evaluations for testing if requirements are met and possibly make improvements, but also to teach the users how to operate the building and check the satisfaction of different users and productivity levels in the organisation. Examples are WODI, POE, ST&M.

5 CONCLUSION

Various evaluation methods for buildings are available. I present a new model, the Evaluation Focus Flower, in which the different methods for evaluating buildings are grouped and ordered on the background of the three Vitruvian qualities of Architecture, in order to easily find the right evaluation method fitting the focus area to study. In this paper I give an example of methods that can be applied at different phases of a hospital building project, and propose which evaluation methods can give best input for the initial briefing process of new hospital facilities with ambition of creating buildings with enhanced usability. Additional information about current use of various evaluation methods is provided from three hospital cases in Denmark and Norway.

The models from this paper can structure thinking about types of evaluations, the reasons for doing evaluation, expected process, focus and results and use of the right tools at the various stages of hospital projects. In that way you can secure both meaningful process and results, but also user involvement, providing a common understanding, inspirations, co-creation and innovation for the future hospital facility.

This paper is part of an ongoing PhD study on Hospital Usability Briefing, therefore the interest and further research will continue in optimising methods that can be used in briefing stages for healthcare facilities. The findings have relevance to researchers and practitioners planning new complex facilities of any kind, not only hospitals.

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March 2013).

9.5. PAPER 5

Fronczek-Munter, A. (2016). Usability Briefing – a conceptual process model based on hospital projects. *CoDesign, International Journal of CoCreation in Design and the Arts*, original paper submitted 24.03.2016

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Paper 5 is confidential until published and is therefore not included in this version of the thesis.